The Welding Engineer

Edited by L. B. Mackenzie

$3.00 per year in U. S. | Reg. U. S. Pat. Office | $4.00 per year abroad

Vol. 7 | 608 S. Dearborn St. | NOVEMBER, 1922 | Chicago, Ill. | No. 11

AIRCO DAVIS APPARATUS

ANYTHING AND EVERYTHING
FOR OXYACETYLENE WELDING AND CUTTING

Public faith in a product is a reflection of faithful performance. Thus, consistently, have Airco Oxygen and Airco Acetylene built up good-will.

AIR REDUCTION SALES COMPANY

Manufacturer of Airco Oxygen—Airco Acetylene—Airco-Davis-Bournonville Welding and Cutting Apparatus and Supplies, Acetylene Generators, and Specially Designed Machines for Automatic Welding and Cutting—Nitrogen, Argon and other Airco Atmospheric Gas Products

Controls the manufacture and sale of National Carbide

Home Office: 342 Madison Avenue, New York, N. Y.

Airco District Offices, Plants and Distributing Stations conveniently located throughout the country.

"Airco Oxygen and Acetylene Service is Good Service."

Published Monthly by the Welding Engineer Publishing Co. Entered as Second Class Matter Jan. 20, 1916, at the Post Office at Chicago, Ill., Under the Act of March 3, 1879.

Reclaiming imperfect Crank Shafts by Oxwelding

No Half-way Measures Here

A crank shaft is a mighty important part of a motor-vehicle. It must be perfect in proportion, truly balanced, strong, and as wear-proof as it is possible to make it.

Oxwelding was used in this case because it is the most perfect way of building up metals, yet devised. That is why the oxwelding blowpipe is in daily use among the makers of motor cars and parts the country over.

Not only does oxwelding and cutting enter largely into the assembly of both chassis and bodies, but the twin processes are invaluable in factory maintenance—insuring quick, permanent and economical repairs on broken and worn machinery.

Oxweld Service Engineers, stationed in more than fifty important cities, will gladly demonstrate how oxwelding and cutting may be applied to your business. There is no charge for such service.

Write for illustrated book "Oxweld Can Do It!"

OXWELD ACETYLENE COMPANY · *Newark, N.J.* · *Chicago* · *San Francisco*

Sales Representatives in the Principal Cities of the World

What Oxweld has done for others—Oxweld can do for you.

An illustrated book "Oxweld Can Do It" tells what oxwelding is doing—write for it

WORLD'S LARGEST MAKER OF EQUIPMENT FOR OXWELDING AND CUTTING METALS

1309-22

WELDING

PUROX

CUTTING

TRADE MARK REGISTERED

APPARATUS AND SUPPLIES

2311 EAST 52nd ST.
LOS ANGELES, CAL.

597 BEAUFAIT ST.
DETROIT, MICH.

1135 THIRD ST.
OAKLAND, CAL.

2920 FIRST AVE., SO.
SEATTLE, WASH.

362 PEIRPONT AVE.
SALT LAKE CITY, UTAH

3030 HURON ST.
DENVER, COLO.

REPRESENTATIVES THROUGHOUT
THE UNITED STATES
CANADA AND MEXICO

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
Prest-O-Lite Co.

ACETYLENE GENERATORS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Metals Welding Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.

ALUMINUM FILLER RODS
Air Reduction Sales Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
Iron City Foundry Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Mach. Co.
Torchweld Equipment Co.
United States Welding Co.

ALUMINUM FLUX
Air Reduction Sales Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Co.
Modern Engineering Co.
Morey Flux & Chemical Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

ALUMINUM SOLDER
Air Reduction Sales Co.
Burdett Oxygen Co.
Liberty Welding Co.
Purox Co.
Metals Welding Co.

ANNEALING FURNACES
Buffalo Dental Mfg. Co.
General Electric Co.

APRONS (Asbestos)
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Purox Co.

ASBESTOS GLOVES
Air Reduction Sales Co.
Burdett Oxygen Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
F. D. Farnam & Co.
Imperial Brass Mfg. Co.
Purox Co.
Universal Oxygen Co.

ASBESTOS SHEET PAPER
Air Reduction Sales Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Purox Co.
Ball Mountain Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.

Rochester Welding Works

We not only do welding, but supervise the design and installation of oxy-acetylene welding plants; report on welding material and methods; make tests on welding apparatus for efficiency and economy.

Nine years' experience.

Rochester Welding Works
349 Orchard St., Rochester, N.Y.

BLOW TORCHES (Acetylene)
See "Torches"

BOOKS (Relating to Welding)
The Welding Engineer
Electric Arc Cutting & Welding Co.

BRASS AND BRONZE FLUX
Air Reduction Sales Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Hauck Mfg. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
United States Welding Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
Universal Oxygen Co.

BRASS SPELTER WIRE
Air Reduction Sales Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Purox Co.
Universal Oxygen Co.
Torchweld Equipment Co.

BRAZING OUTFITS
Bastian-Blessing Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
Imperial Brass Mfg. Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

BRONZE FILLER RODS
Air Reduction Sales Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
Burdett Oxygen Co.
Hauck Mfg. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

CABLE (For Leads)
Electric Arc Cutting & Welding Co.
General Electric Co.
Metals Welding Co.
Quasi-Arc Weldtrode Co.
Transportation Engineering Corp.
Wilson Welder & Metals Co.

CARBIDE (Calcium)
Air Reduction Sales Co.
American Carbolite Sales Co.
Carbic Mfg. Co.
Gas Tank Recharging Co.
Shawinigan Products Corp.
Standard Carbide Sales Co.
Union Carbide Sales Co.

CARBIDE (Compressed in Cakes)
Carbic Mfg. Co.

CARBON (Blocks, Paste, Etc.)
Air Reduction Sales Co.
National Carbon Co.
U. S. Welding Co.
Electric Arc Cutting & Welding Co.

CARBON REMOVING TORCHES
See "Torches"

CAST IRON FILLER RODS AND FLUX
Air Reduction Sales Co.
Burdett Oxygen Co.
Bierman-Everett Fdy. Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
B. Dieden Co.
Electric Arc Welding & Cutting Co.
Hauck Mfg. Co.
International Oxygen Co.
Modern Engineering Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Imperial Brass Mfg. Co.
Page Steel & Wire Co.
John A. Roebling's Sons Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
Transportation Engineering Corp.
United States Welding Co.

COPPER FLUX
Air Reduction Sales Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Purox Co.
Imperial Brass Mfg. Co.

CUTTING RODS (Elec. Arc)
Electric Arc Cutting & Welding Co.

CYLINDERS
Wm. Wharton, Jr., & Co.

ELECTRIC ARC WELDING OUTFITS
Electric Arc Welding & Cutting Co.
General Electric Co.
Lincoln Elec. Co.
Quasi-Arc Weldrode Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

UNIFORMITY

Over two miles of Electrode Wire used per reel on these General Electric automatic and semi-automatic welders without any interruption of the arc.

This is convincing evidence of uniform wire, which is the result of a pure metal combined with scientific wire manufacturing methods.

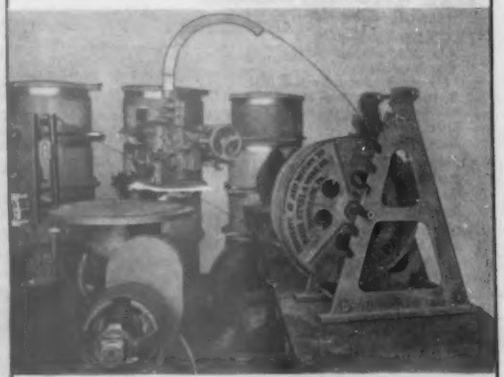
Page-Armco Welding Rods and Electrodes are the purest iron made in commercial quantities—99.84% iron—and conform in all respects to American Welding Society Specifications for Electrodes E-No. 1-A. Specifications for Gas Welding Rods G-No. 1-A.

Yellow tag denotes Gas Welding Rods. Ends of rods colored yellow.

Blue tag denotes Electrodes. Ends of rods colored blue.

Page-Armco Electrode Wire on Metal Reel

General Electric Semi-Automatic Arc Welder with Reel of Page-Armco Electrode Wire



General Electric Automatic Arc Welder, with Reel of Page-Armco Electrode Wire

Page Steel and Wire Company

Bridgeport, Connecticut

INGOT IRON

MANUFACTURERS OF

RODS—Armco Ingot Iron and Special Analysis Steels.

WIRE—Plain and Galvanized—Spring, Rope, Telephone, Telegraph, Bond, Strand, Oxy-Acetylene and Electric Welding Wire.

FENCE—Woven Wire for Farm and Railway Right of Way, Wire Link Protection for Industrial Plants, Lawns, Schools, and Estates, and Factory Partitions.

Carried in stock by distributors in all industrial centers.

District Sales Offices

Chicago New York Pittsburgh Portland, Ore. San Francisco

PAGE-ARMCO

WELDING RODS and ELECTRODES

ELECTRODE HOLDERS
Electric Arc Welding & Cutting Co.
General Electric Co.
Quasi-Arc Weldtrode Co.
Transportation Engineering Corp.
Wilson Welder & Metals Co.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
Burdett Oxygen Co.
International Oxygen Co.
Universal Oxygen Co.

FILLER RODS (Swedish Iron)
Air Reduction Sales Co.
Bierman-Everett Fdy. Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Wm. Cramp & Sons
Electric Arc Cutting & Welding Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
Modern Engineering Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Page Steel & Wire Co.
Superior Oxy-Acetylene Machine Co.
Transportation Engineering Corp.

FILLER RODS (Tobin Bronze)
Air Reduction Sales Co.
Burdett Oxygen Co.
Central Steel & Wire Co.
Bierman-Everett Fdy. Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Page Steel & Wire Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

FILLER RODS (Vanadium Steel)
Air Reduction Sales Co.
Burdett Oxygen Co.
Bierman-Everett Fdy. Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Universal Oxygen Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Oxweld Acetylene Co.
Reid-Avery Co.
Torchweld Equipment Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.

FIREPROOF PLASTIC
National Carbon Co.
U. S. Welding Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Smith's Inventions, Inc.

FURNACES (Annealing)
Buffalo Dental Mfg. Co.
General Electric Co.
Hauck Mfg. Co.

GAS BURNERS (Preheating)
Air Reduction Sales Co.
Davis-Bournonville Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Weldit Acetylene Co.

GAUGES
U. S. Gauge Co.

GENERATORS (Oxygen or Hydrogen)
Burdett Oxygen Co.
International Oxygen Co.

GLOVES (Welders Asbestos)
Air Reduction Sales Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
International Oxygen Co.
Imperial Brass Mfg. Co.
Purox Co.
Torchweld Equipment Co.

GOGGLES
Air Reduction Sales Co.
Carbic Mfg. Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Quasi-Arc Weldtrode Co.
Transportation Engineering Corp.

GRINDING MACHINES
N. A. Strand Co.
Transportation Engineering Corp.
Wedack Electrical Tool Corporation.

HARDENING FURNACES
Buffalo Dental Mfg. Co.
General Electric Co.
Hauck Mfg. Co.

HOSE (Oxygen and Acetylene)
Air Reduction Sales Co.
Burdett Oxygen Co.
Buffalo Dental Mfg. Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
International Oxygen Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

HOSE UNIONS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

HYDROGEN
Burdett Oxygen Co.
Gas Products Association
International Oxygen Co.

HYDROGEN PLANTS
Burdett Oxygen Co.
International Oxygen Co.
Universal Oxygen Co.

KEROSENE PREHEATING TORCHES
Air Reduction Sales Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.

NEEDLE VALVES
Air Reduction Sales Co.
Burdett Oxygen Co.
The Bastian-Blessing Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Federal Brass Works.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

NITROGEN
Air Reduction Sales Co.
Linde Air Products Co.

OIL BURNERS (Preheating)
Air Reduction Sales Co.
Carbic Mfg. Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.

OXY-ACETYLENE CUTTING MACHINES
Davis-Bournonville Co.
Air Reduction Sales Co.

OXYGEN (Compressed in Cylinders)
Air Reduction Sales Co.
Burdett Oxygen Co.
Gas Products Ass'n.
International Oxygen Co.
The Linde Air Products Co.
Purox Co.
Swift & Co.

OXYGEN AND HYDROGEN GENERATING EQUIPMENT
Burdett Oxygen Co.
Gas Products Assn.
International Oxygen Co.
Universal Oxygen Co.

OXYGEN PLANTS (Liquefaction)
M. Keith Dunham

PREHEATING FURNACES
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Superior Oxy-Acetylene Machine Co.

PRESSURE GAUGES
Air Reduction Sales Co.
Bastian & Blessing Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
Torchweld Equipment Co.
United States Welding Co.

REGULATING VALVES (Acetylene)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Federal Brass Works
Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

REGULATING VALVES (Hydrogen)
The Bastian-Blessing Co.
Burdett Oxygen Co.
Federal Brass Works
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
K-G Welding & Cutting Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Smith's Inventions, Inc.
Torchweld Equipment Co.

REGULATING VALVES (Oxygen)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Federal Brass Works
Imperial Brass Mfg. Co.
Purox Co.
Smith's Inventions, Inc.

SAND BLAST
Transportation Engineering Corp.

SCORED CYLINDERS
L. Lawrence & Co.

SEAM WELDERS (Electric)
General Electric Co.

SOLDERS
Liberty Welding Co.

TORCHES (Oxy-Acetylene Welding and Cutting)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Carbic Mfg. Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Federal Brass Works
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Metals Welding Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Prest-O-Lite Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

TORCHES (Oxy-Hydrogen Welding and Cutting)
The Bastian-Blessing Co.

Texas Headquarters for Welding and Cutting. The Best Equipped Plant in the State.
Southern Welding & Machine Co.
212-14 College Street
San Antonio, Texas

Burdett Oxygen Co.
Davis-Bournonville Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Smith's Inventions, Inc.
Torchweld Equipment Co.
United States Welding Co.

TANK CONNECTIONS (Oxygen and Acetylene Adaptors)
Air Reduction Sales Co.
Davis-Bournonville Co.
International Oxygen Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
The Imperial Brass Mfg. Co.
Torchweld Equipment Co.

TORCHES (Gasoline and Kerosene Preheating)
Air Reduction Sales Co.
Buffalo Dental Mfg. Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.

UNION CARBIDE

WORLD'S BEST QUALITY—HIGHEST GAS YIELD

ALWAYS PACKED IN BLUE AND GRAY DRUMS

Large stocks of Union Carbide in all regular commercial sizes are carried at each of Union Carbide Sales Company's Warehouses listed below.

Requests for information and special correspondence should be addressed to our New York, Chicago or San Francisco offices.

Generator Sizes of Union Carbide

Packed in 100 Pound Drums

3½ in. x 2	in.	(Lump)
2 in. x ½	in.	(Egg)
1¼ in. x ⅜	in.	(Nut)
¼ in. x 1/12	in.	(Quarter)

For Oxy-Acetylene Welding and Cutting Plants, Acetylene House Lighting Plants, Contractors' Torches and Flare Lights, and numerous other pieces of Acetylene generating apparatus designed for the use of one of these sizes of Carbide.

UNION CARBIDE SALES COMPANY

Peoples Gas Building
Chicago, Ill.

Carbide and Carbon Building
30 East 42nd St.
New York

Balfour Building
California and Sansome Sts.,
San Francisco, Calif.

UNION CARBIDE SALES COMPANY'S WAREHOUSES

Shipments Always Made On Day Orders Are Received

ALABAMA
Birmingham.....1916 Morris Ave.
Mobile.....16 S. Commerce St.
Montgomery.....114 N. Perry St.

ARIZONA
Phoenix.....42 S. Central Ave.

ARKANSAS
Ft. Smith.....122 S. Ninth St.

CALIFORNIA
Fresno.....932 H St.
Los Angeles.....639 Gibbon St.
Sacramento.....217 O St.
San Diego.....Seventh and J Sts.
San Francisco.....Balfour Bldg.

COLORADO
Denver.....Nineteenth and Waxee Sts.

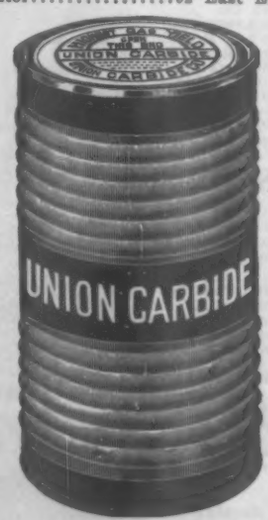
CONNECTICUT
Hartford.....412 Trumbull St.

DISTRICT OF COLUMBIA
Washington.....501 Second St., N. E.

FLORIDA
Jacksonville.....13 Cedar St.
Tampa.....805 Tampa St.

GEORGIA
Atlanta.....P. O. Box 1594
Savannah, Ogeechee Canal, S. of Bay St. P. O. Box 78

ILLINOIS
Chicago.....122 So. Michigan Boulevard
Danville.....511 Oak St.
Decatur.....133 W. William St.
East St. Louis.....700 Broadway
Phones Bell-Bridge 320, Kinloch-St. Clair 320
Marion..315 S. Granite St., P. O. Box 747
Monmouth.....124 E. Archer Ave.
Peoria.....100-110 Edmund St.
Phones Main 700-701, Interstate 7000
Quincy.....313 Delaware St., Phone 220
Springfield.....1801 Washington St.
Streator.....702 East Elm St.



INDIANA
Evansville.....1601 Illinois St.
Fort Wayne.....2216 Broadway
Indianapolis.....110-112 S. Alabama St.
Phones Bell-Main 2410, Independent 27-474
Terre Haute.....921 Wabash Ave.

IOWA
Davenport.....118 Harrison St.
Des Moines.....Third and Elm Sts.
Dubuque.....8th and Washington Sts.
Fort Dodge.....Central Ave. at 16th St.
Ottumwa.....207-9-11 S. Washington St.
Sioux City..325 Fourth St., P. O. Box 393
Waterloo.....1209 East Fourth St.

KANSAS
Pittsburg.....109 W. Third St.
Salina.....154 N. Fifth St.
Wichita....Douglas and Sycamore Aves. P. O. Box 951

KENTUCKY
Allen .....
Louisville.....126 E. Main St.
Middlesboro.....1701 Cumberland Ave.

LOUISIANA
New Orleans.....4124 Toulouse St.

MAINE
Portland.....11 Exchange St.

MARYLAND
Baltimore.....19 E. Lombard St.
Cumberland....52 Third Nat'l Bk. Bldg.
Salisbury...Mill St., Opp. Fulton Station

MASSACHUSETTS
Springfield ..... Napier St.
Worcester..... 15 Federal St.

MICHIGAN
Detroit.....Federal and Junction Aves.
Grand Rapids..500 Shawmut Ave., N. W.
Hancock.....First Nat'l Bank Bldg.
Iron Mountain.....513 Stephenson Ave.
Jackson.....172 South Water St.
Muskegon.....303 W. Western Ave.
Saginaw.....1830-1840 N. Michigan Ave.
Sault Ste. Marie.....

MINNESOTA
Minneapolis.....324 N. First St.
Phones Nicollet 7121, Tri City-Automatic 38634
Virginia.....413 Chestnut St.

MISSISSIPPI
Vicksburg.....1312 Washington St.

MISSOURI
Kansas City.....1422 St. Louis Ave.
St. Joseph.....920 Sixth St., Sta. "A."
St. Louis.....(See East St. Louis, Ill.)

NEBRASKA
Omaha.....1007-9-11 Jones St.
Union Sta. P. O.

NEW JERSEY
Camden.....West and Clinton Sts.
Newark.....251-55 Ridgewood Ave.

NEW YORK
Albany.....102 Third Ave.
Binghamton.....21 Jarvis St.
Phones Long Distance 467, York State 210, Bell 2450
Buffalo.....1336 Genesee St.
Geneva.....Exchange St. & R. R. Place
Hurleyville .....
Jamaica.....11 New York Ave.
Kingston.....O'Neil St., Near Broadway
Niagara Falls .....
Poughkeepsie.....Smith St. and N. Y., N. H. & H. R. R. Tracks
Utica..... 135 Hotel St.
Watertown..... 438 Court St.
Whitehall..... 22-28 Main St.

NORTH CAROLINA
Charlotte.....205 W. First St.
Wilmington.....13 N. Front St.
Raleigh.....P. O. Box 146

NORTH DAKOTA
Fargo.....Fifth St. and Second Ave.

OHIO
Athens.....Factory and Moore Sts.
Canton.....618 Mulberry Road, S. E.
Cincinnati..67 Plum St., Phone Main 682
Cleveland.....601 The Citizens' Bldg.
Columbus.....310 Dublin Ave.
Dayton.....812-828 E. First St.
Lima.....338 East High St.
Mansfield...40 West Third St., Phone 69
Steubenville.....324-343 N. Seventh St.
Toledo.....414 S. Erie St.
Youngstown.....Jones and Brittain Sts.
Zanesville.....Main and 2nd Sts.

OKLAHOMA
McAlester.....8 N. Main St.
Oklahoma.....4 West Park Place
Tulsa.....1-11 N. Boulder St.

OREGON
Portland.....15th and Hoyt Sts.

PENNSYLVANIA
Beaver..... 359 Beaver St.
DuBois....Weber Ave. and Franklin St.
East Greensburg..Clark and George Sts.
Erie..... 1426 Chestnut St.
Harrisburg.....25 S. Tenth St.
Johnstown, Messenger St. and B. & O. R.R.
Pittsburgh .....
.....1202 Chamber of Commerce Bldg.
Pottsville....Railroad and Sanderson St.
Scranton.....Penn Ave. and Vine St.
Shamokin.....Fifth and Walnut Sts.
Williamsport.....Canal and Court Sts.

SOUTH CAROLINA
Charleston..3 N. Liberty St., Phone 2716

TENNESSEE
Chattanooga .....
...627 Volunteer State Insurance Bldg.
Knoxville.....426 West Depot Ave.
Memphis.....671 South Main St.
Nashville..... 105-107-109 Broadway

TEXAS
Dallas.....Wood and Market Sts.
El Paso..First and Kansas Sts., Phone 50
Houston .....
..Baker and Cedar Sts., P. O. Box 1214
San Antonio.....115 Medina St.
Waco..Thirteenth & Mary Sts., Phone 28

UTAH
Salt Lake City..108 W. Second South St.

VIRGINIA
Lynchburg..... 1224 Commerce St.
Norfolk..... 513 Front St.
Richmond.....18th and Cary Sts.

WEST VIRGINIA
Bluefield.....195 Roanoke St.
Charleston..Broad St. and K. & M. R. R.
Elkins.....Railroad Ave. and First St.
Fairmont ..... "A" St.
Huntington...Seventh Ave. & Eighth St.
Morgantown.....178 Clay St., Phone 20
Wheeling.....42rd and McCulloch St.

WASHINGTON
Seattle.....508 Westlake Ave., North
Spokane..162 So. Post St., Phone Riv-96

WISCONSIN
La Crosse.....Front and King Sts.
Madison..... 513-19 Williamson St.
Milwaukee..... 120 Jefferson St.

UNION CARBIDE IS EASILY OBTAINABLE EVERYWHERE

Weldite Welding Rods

Made from a distinctive wrought iron of great purity and possessing unique welding qualities. Furnished in different grades for Gas or Electric Arc Welding, in coils and cut to length, and in Bare Finish, Coppered or Flux Coated.

Full particulars, prices and samples on request.

Manufactured by

CHICAGO STEEL & WIRE CO.
103rd Street & Torrence Avenue, Chicago, Ill.

Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
International Oxygen Co.
Modern Engineering Co.
Prest-O-Lite Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
The Imperial Brass Mfg. Co.
Torchweld Equipment Co.

TRUCKS (Cylinder Carriers)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Burdett Oxygen Co.
Davis-Burnonville Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

VALVES (For Oxygen Cylinders)
Air Reduction Sales Co.
Burdett Mfg. Co.
International Oxygen Co.

WELDING APPARATUS (Electric)
Electric Arc Welding & Cutting Co.
General Electric Co.
Lincoln Elec. Co.
Quasi-Arc Weldtrode Co.
Westinghouse Elec. Mfg. Co.
Wilson Welder & Metals Co.

WELDERS' GLOVES
Air Reduction Sales Co.
Carbic Mfg. Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
International Oxygen Co.
Purox Co.
The Imperial Brass Mfg. Co.
Transportation Engineering Corp.

WELDERS' GOGGLES
Air Reduction Sales Co.
Burdett Oxygen Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Modern Engineering Co.
Purox Co.
Quasi-Arc Weldtrode Co.
Transportation Engineering Corp.

WELDERS MASKS
Chicago Eye Shield Co.
Electric Arc Welding and Cutting Co.
General Electric Co.
Torchweld Equipment Co.
Transportation Engineering Corp.
Wilson Welder & Metals Co.

WELDING RODS AND WIRE
Air Reduction Sales Co.
Electric Arc Cutting & Welding Co.
Bierman-Everett Fdy Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
William Cramp & Son
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Managanese Steel Forge Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Page Steel & Wire Co.
Quasi-Arc Weldtrode Co.
Purox Co.
Reid-Avery Co.
John A. Roebling's Sons Co.
Torchweld Equipment Co.
Transportation Engineering Corp.
Wilson Welder & Metals Co.

WELDING ROD HOLDERS
C. Sorensen.

WIRE AND CABLE (Asbestos Insulated)
Central Steel & Wire Co.
D. & W. Fuse Works, General Electric Co

ALPHABETICAL INDEX TO ADVERTISERS

Air Reduction Sales Co.....Front Cover
American Carbolite Sales Co..... 52
American Welding Society..... 16

B

Bastian-Blessing Co., The.....26-27
Bierman-Everett Fdy. Co..... 50
The Buckeye Welding & Sup. Co..... 50
Buffalo Dental Mfg. Co..... 13
Burdett Mfg. Co.....14

C

Carbic Mfg. Co..... 51
Central Steel & Wire Co..... 43
Chicago Eye Shield Co.....43
Chicago Steel & Wire Co..... 8
Commercial Acetylene Supply Co..... 9
Wm. Cramp & Sons..... 12

D

Davis-Bournonville Co. 49

E

Electric Arc Welding & Cutting Co..... 50
Everstay Sales Co..... 52

F

Federal Brass Works..... 13

G

Gas Products Assn..... 11
Gas Tank Recharging Co..... 10
General Electric Co..... 33

H

Hauck Manufacturing Co..... 10

I

Imperial Brass Mfg. Co..... 50
International Oxygen Co.....

K

K-G Welding & Cutting Co..... 10

L

Linde Air Products Co..... 18
Lincoln Electric Co.....
L. Lawrence & Co..... 16

M

Manganese Steel Forge Co..... 49
G. & C. Merriam Co..... 49
Morey Flux & Chemical Co..... 50
Modern Engineering Co..... 13

N

National Carbon Co..... 50

O

Oxweld Acetylene Co..... 2

P

Page Steel & Wire Co..... 5
The Prest-O-Lite Co., Inc..... 31

Q

Quasi-Arc Weldtrode Co..... 50

E

Reid-Avery Co..... 45
Rochester Welding Works..... 4
Roebling, John A., Sons Co..... 14

S

Sall Mountain Co..... 47
C. Sorensen 50
Superior Oxy-Acetylene Machine Co..... 49
Southern Welding Machine Co..... 6
Shawinigan Products Corporation..... 12
Smith's Inventions, Inc..... 14
Standard Carbide Sales Co., Inc..... 11
N. A. Strand & Co..... 50
Swift & Co.....

T

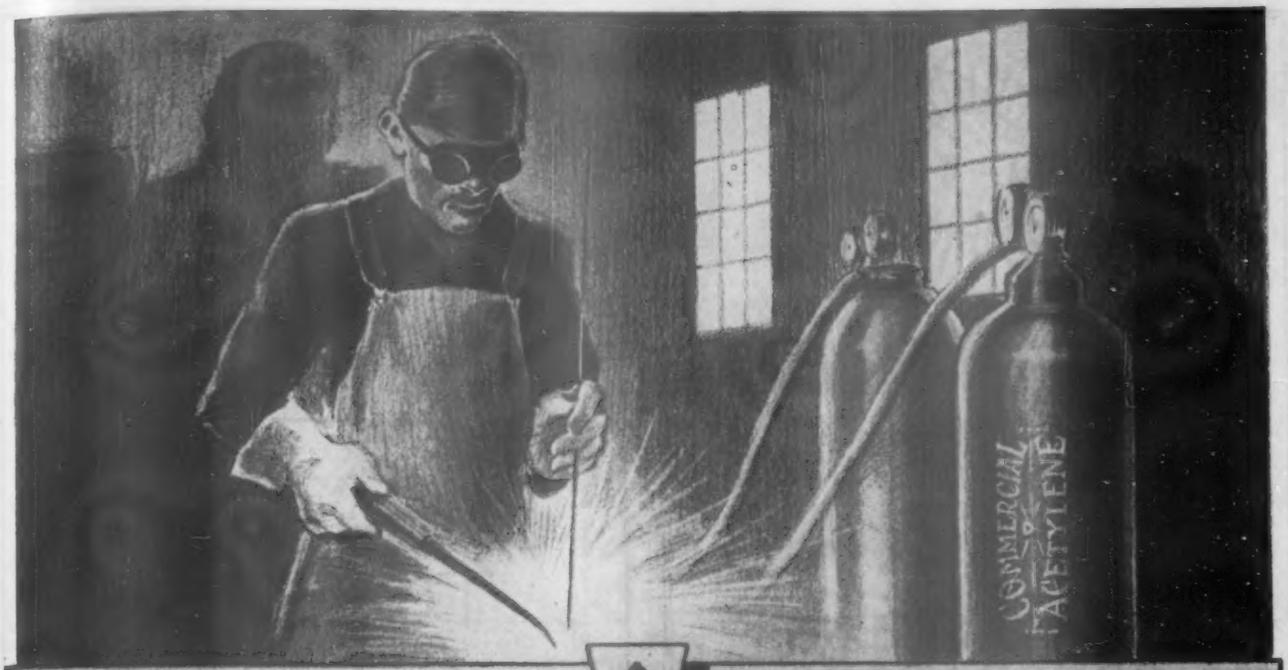
Torchweld Equipment Co..... 45
Transportation Engineering Corp..... 13

U

Union Carbide Sales Co..... 7
U. S. Gauge Co.....
United States Welding Co..... 49

W

Westinghouse Electric Mfg. Co.....38, 39
Wm. Wharton, Jr., & Co., Inc..... 50
Wilson Welder & Metals Co..... 16
Wodack Electric Tool Corporation..... 48



The right foundation for good welding is pure gas.

Commercial Acetylene is made for the welder who takes pride in making strong welds.

Our pride is not so much in the amount of acetylene we sell as in the purity of our product.

Are you acquainted with the Commercial sales plan? Thousands are.

Build your business on Commercial Acetylene.

Supplied in the following sized cylinders:

10x30	in.	size	approx.	capacity	125	cu.	ft.
12x36	"	"	"	"	225	"	"
12x44	"	"	"	"	275	"	"

Commercial Acetylene Supply Company

Main Office: 80 Broadway, New York City
542 S. Dearborn St., Chicago

Atlanta, Ga.
East Deerfield, Mass.
San Francisco, Calif.

Boston, Mass.
Los Angeles, Calif.
Bound Brook, N. J.

Toronto, Ont.
Blue Island, Ill.
W. Berkeley, Calif.

SUN-LITE

BRAND

CALCIUM CARBIDE

Is made from best grade of coke and lime. Scientifically treated in an electric furnace so as to produce carbide of excellent quality and large gas yield.

For ACETYLENE GENERATORS

Sizes

3½x2
2x½
1¼x⅜
¼x1/12

Packed in non-returnable steel drums containing 100 lbs. net.

Manufactured by

Gas Tank Recharging Co.

Works: Keokuk, Iowa

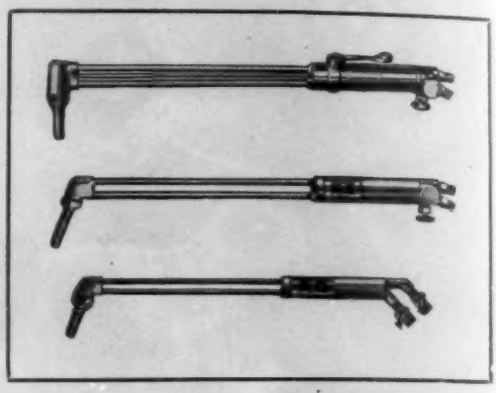
General Office: - Milwaukee, Wis.

Distributed by

Magnolia Gas Products Co.

Houston, Texas
San Antonio, Texas

SUN-LITE



K-G
Cutting Welding
TORCHES

Any Length Desired
for Any Gas Desired

K-G Welding and Cutting Co., Inc.

Home Office and Factory
556 West 34th St., N. Y. City
SALES OFFICES:
Philadelphia, Pittsburgh, Chicago, Springfield, Mass. Norfolk

HAUCK
Kerosene Preheaters

Reduce { your labor costs; your oxy-acetylene costs; your failures

Increase { your production; your quality of welds; your profits

Drop us a line for details and ask for booklet No. 127

HAUCK MANUFACTURING CO.

122 Tenth St. Brooklyn, N.Y.

"You bet—Standard Carbide for every job"

Smiling Dave Okay

WHEN I started using STANDARD CARBIDE my work began to pick up. I could work faster because STANDARD is pure carbide, nothing in it to cause the flame to flicker or die and so slow up my work. Because I worked faster I could do more work and because the work I did with STANDARD was above the average, the boss got more jobs and I had more work to do.

When the boss talks about service now he's not just talking. He means STANDARD SERVICE and that's service with a capital S.

We're all strong for it, the foreman (that's me). because it gave me my reputation, the men because they do better work, and the boss because STANDARD costs no more than any other kind of carbide.

Smiling Dave Okay
(EXPERT CUTTER AND WELDER)

STANDARD CARBIDE not only gives a steady even glow of acetylene gas but it lasts longer and costs no more. It is absolutely free from all impurities. It is a favorite among expert welders and cutters.

STANDARD
TRADE MARK
CARBIDE
Burns Brighter—Lasts Longer

Standard Carbide Sales Co., Inc.
Main Office : : 15 West 37th St., New York

"I GUESS—"

TOO often a guess regarding materials means as little as a guess about the weather.

A careful selection of materials should be based on a study of facts,—not guesses.

The Engineer whom you employ thinks below the surface; knows that the foundation must be well secured; knows the relative value of the materials he recommends. His technical knowledge gives weight to his opinion, which the layman accepts without doubt.

So should you select the right process if you wish to have better welds. In other words, do not substitute any other process when oxy-acetylene welding should be employed for best results.

Let us prove to you the value of "QUALITY" and "PERSONAL SERVICE," by placing your next order with one of the members of the GAS PRODUCTS ASSOCIATION in your territory.

CALIFORNIA
California Compressed Gas Co., Los Angeles
California Compressed Gas Co., Oakland

COLORADO
Colorado Compressed Gas Co., Denver

ILLINOIS
Acme Oxygen Co., Chicago
Burdett Oxygen & Hydrogen Co., Chicago
Electrox Co., Peoria
National Oxygen Co., Chicago
Swift & Co., Chicago

INDIANA
Indiana Oxygen Co., Indianapolis
Logansport Oxygen Co., Logansport

IOWA
Bettendorf Oxygen Hydrogen Co., Bettendorf

KENTUCKY
Kentucky Oxygen & Hydrogen Co., Louisville

LOUISIANA
Louisiana Oxygen Co., Inc., New Orleans

MANITOBA
Auto-Lite Gas Co., Ltd., Winnipeg

MICHIGAN
Burdett Oxygen Co. of Detroit, Detroit
Michigan Ox-Hydric Co., Muskegon
National Oxygen & Machinery Co., Detroit

MINNESOTA
Commercial Gas Co., Minneapolis

MISSOURI
Kansas City Oxygen Gas Co., Kansas City (two plants in Kansas City)
St. Louis Oxygen Co., St. Louis

MONTANA
Mountaineer Welders' Supply Co., Butte

NEBRASKA
The Balbach Co., Omaha

OHIO
Clarke Chemical Co., Wickliffe
Ohio Electrolyte Oxygen Co., Cincinnati

OKLAHOMA
Burdett Oxygen Co. of Oklahoma, Oklahoma City
Tulsa Oxy-Hydro Co., Tulsa

OREGON
Portland Oxygen & Hydrogen Co., Portland

PENNSYLVANIA
Burdett Oxygen Co., Philadelphia (plants at Chester and Norristown)
Burdett Oxygen & Hydrogen Co., Pittsburgh
National Oxygen Co., Erie

TENNESSEE
Burdett Oxygen Co., Chattanooga
Memphis Oxygen Co., Memphis

TEXAS
Burdett Oxygen Co. of Texas, Fort Worth
Magnolia Gas Products Co., Houston

UTAH
Utah Compressed Gas Co., Salt Lake City

WASHINGTON
Washington Compressed Gas Co., Seattle

WISCONSIN
Universal Oxygen Co., Sheboygan
Wisconsin Oxygen & Hydrogen Co., Kenosha

Gas Products Association
140 S. Dearborn Street CHICAGO, ILL.

WELDING RODS

Parsons' Manganese Bronze Rolled Welding Rods

the Strongest Bronze Made

for high-fire Brazing and Oxy-Acetylene Welding of Malleable Iron or Bronze and Brass castings assure a faultless, flawless job. This is another example of the "Cramp" standard of quality. This scientifically perfected metal is the result of long years of experience. Its fine physical properties make it especially suitable for welding purposes.

A strong weld of fine close grain and exceedingly tough texture is always the result where Cramp's Welding Rods are usesd.

We can also furnish Welding Rods of Cramp's Cast Iron, Cramp's Copper Covered Iron, Cramp's Vanadium Steel, Cramp's Drawn Aluminum, Cramp's Cast Aluminum, Cramp's American Iron and Soft Brass Brazing Wire.

CRAMP

We furnish and will be glad to estimate on all kinds of brass and bronze castings.

The William Cramp & Sons Ship & Engine Building Co., Philadelphia

Our business is Good— it ought to be—

CANADIAN CARBIDE

is Good Carbide

SHAWINIGAN PRODUCTS CORPORATION 110 WILLIAM ST. NEW YORK

SHAWINIGAN

BLOWPIPES

BLOWPIPES for Radiator repairing.
BLOWPIPES for light brazing.
BLOWPIPES for heavy brazing.
BLOWPIPES for lead burning.
BLOWPIPES for heating work to be welded by the oxy-acetylene process.

Let us know your requirements and we will give you the benefit of our many years' experience in blowpipe work.

Our catalog "BX" illustrates and describes them all. Ask for it.

BUFFALO DENTAL MANUFACTURING CO.
BUFFALO, N. Y., U. S. A.

MECO MULTI-SEAT REGULATORS have four seats instead of one, but cost no more.

Write for prices and start to reduce your costs — NOW.

Modern Engineering Company
3411 Pine Street - - - St. Louis, U. S. A.

Federal Regulators Help SELL Your Torches

100% Efficient
Cheapest in the End

Improve Your Torches By Using "Federal" Regulators

"Ask for Catalog"

FEDERAL BRASS WORKS
3100 SOUTH KEDZIE AVENUE, CHICAGO

Wanamaker Coated Electrodes
FOR
ARC WELDING

COATED WANAMAKER ELECTRODES

Reduce your labor costs.
Reduce your current costs.
Reduce your electrode material costs.

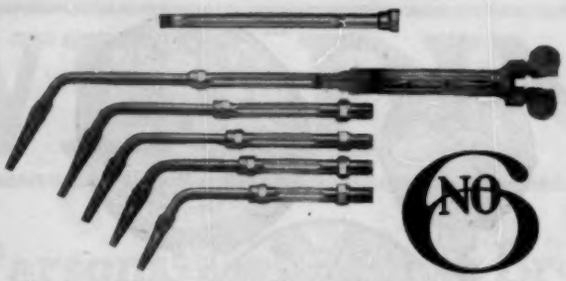
Increase your production.
Increase the operators' efficiency.
Increase the quality of your welds.

Write for details.

The new Tecor Specialties Bulletin describes the WANAMAKER COATED ELECTRODES, also a complete line of welding accessories.

Write for it today.

Transportation Engineering Corporation
15 PARK ROW, NEW YORK CITY.
608 SOUTH DEARBORN ST., CHICAGO, ILL.



Longer Life For Six Reasons

Each of the six tips you get with this torch is a reason why it lasts so long.

You Get Six In One For The Price of One

Every torch user ought to investigate this torch—write for the facts.

Address Dept. B.

Exclusive Manufacturers of **SMITH'S INVENTIONS INCORPORATED** *Welding and Cutting Equipment*

MINNEAPOLIS, MINN.

DISTRIBUTORS

Campbell Iron Co.	St. Louis, Mo.
Electric Appliance Co.	Chicago, Ill.
Omaha Welding Co.	Omaha, Nebr.
Omaha Baum Iron Co.	Omaha, Nebr.
Bonniwell Calvin Iron Co.	Kansas City, Mo.
Holter Hdwe. Co.	Spokane, Wash.
James Supply Co.	Chattanooga, Tenn.
Big Three Welding & Equip. Co.	Ft. Worth, Tex.
Williams Hdwe. Co.	Minneapolis, Minn.
The Moore Hdwe. & Iron Co.	Denver, Colo.
Young & Vann Supply Co.	Birmingham, Ala.
Taylor Parker Co.	Norfolk, Va.
Motor Mercantile Co.	Salt Lake City, Utah
Seattle Oxygen Co.	Seattle, Wash.
Watterhouse & Lester Co.	San Francisco, Calif. Los Angeles, Calif.; Portland, Ore.
Motor Equipment Co.	Wichita, Kans.
Shadbolt & Boyd Iron Co.	Milwaukee, Wis.
Tull Rubber & Supply Co.	Atlanta, Ga.
Mine & Smelter Supply Co.	Salt Lake City, Utah
Hippee-States Co.	Des Moines, Iowa
Sioux City Iron Co.	Sioux City, Iowa
W. J. Holliday	Indianapolis, Ind.
Robert Donahue Co.	Burlington, Ia.

Roebling Welding Wire

Conforming to Spec. E1B and G1A of The American Welding Society

ROEBLING ELECTRODES

Absolutely uniform in quality

Roebling Wire Electrodes are supplied in the following standard sizes: ¼-in.; 5/32-in.; 3/16-in.; 1/8-in.; 3/32-in.; 1/16-in.; 1/32-in., having a standard length of 14-in., in bundles 50 lbs. each, and are always available for quick shipment. Sizes other than the above and as large in diameter as ¼-in., having any length required, either straightened or in coils can be furnished on order. Roebling Electrodes give maximum penetration and maximum strength of welds.

ROEBLING GAS WELDING STICKS

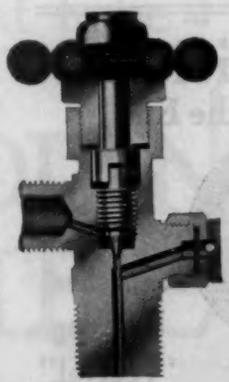
99.75% Pure Iron

Roebling Wire Gas Welding Sticks are copper coated to distinguish them easily from Roebling Electrodes. They are supplied in standard sizes: 3/16-in.; 5/32-in.; ¼-in.; 5/16-in.; 3/8-in.; 7/16-in.; 1/2-in.; and in standard lengths of 36 in. in bundles weighing 50 lbs. each, well protected by weatherproof paper or burlap. Sizes other than the above either straightened or in coils can be furnished on order.

JOHN A. ROEBLING'S SONS CO.

TRENTON, N. J.

Make the BURDETT STANDARD your Standard



Hundreds of gas users are better satisfied today than ever before because their cylinders are equipped with the

BURDETT STANDARD High Pressure Valve

The rugged construction and superior design of this valve has won popularity for it in every section of the country. It combines the features of gas economy, extreme durability, and low cost.

Write today for particulars.

BURDETT MANUFACTURING CO.

309 St. Johns Ct. CHICAGO, ILL.

A Short Story Prize Contest for Welders

The Welding Engineer wants good welding stories; stories which will be helpful to the other fellow. In order to be sure of getting the best stories which welders can contribute from their experience, we are putting them on a competitive basis, and are offering three prizes for the three best stories submitted each month, as follows:

1st Prize: Class C Membership in American Welding Society.

2nd Prize: Class D Membership in American Welding Society.

3rd Prize: Copy of Welding Encyclopedia bound in Leather, Stamped with Owner's Name.

CONDITIONS

There is no restriction as to the length of this story, or the time in which the work is done. The assignment of prizes will be based on the value of the story as a whole to the readers of The Welding Engineer. Manuscript does not have to be typewritten, and it will not be judged upon its literary merits. If sketches are necessary to illustrate any features of the work, you need not submit finished drawings. Pencil sketches will serve the purpose just as well. One point to be kept in mind is that the story ***should be complete enough to enable another welder to do the same job after reading it.*** There is no restriction regarding the nature of the work described. It may be either production work or repair work. It may be oxy-acetylene welding, electric arc welding or thermit welding. The value of the story may consist entirely of a description of the method of preheating in the case of a repair job, or in the construction of a jig in the case of production work. The purpose of the contest is to bring out practical working instructions which will enable the other fellow to do a particularly difficult piece of work.

In case manuscripts are received which are considered good information for our readers, but which are not quite so good as the stories which are winners in the prize contest, they may be printed in The Welding Engineer, in which case the story will be paid for at our regular rates.

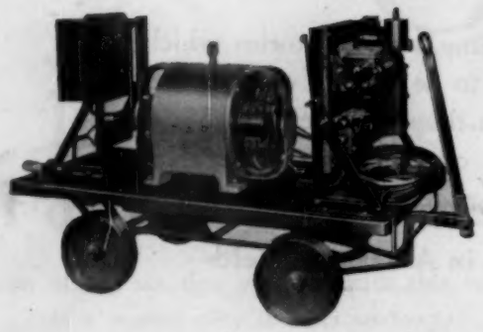
Mail your best welding story to

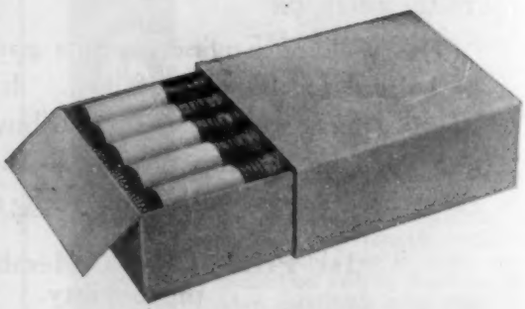
THE WELDING ENGINEER PUBLISHING CO.

608 South Dearborn Street CHICAGO, ILLINOIS

FOR ARC WELDING

Cast Iron
Malleable Iron
Steel
Brass
Bronze
Monel Metal





Specify

WILSON WELDERS and "Color-tipt" METALS

WILSON WELDER & METALS CO. 132 King Street, New York, N. Y.

PITTSBURGH PHILADELPHIA BALTIMORE DETROIT CHICAGO
BIRMINGHAM BARTLESVILLE, OKLA. SAN FRANCISCO LOS ANGELES MONTREAL

SERVICE PLANTS

Buffalo, N. Y. 846 Main St.	Cleveland, Ohio 6529 Euclid Ave.	Minneapolis, Minn. 14 No. 9th St.	Pittsburgh, Pa. 5182 Baum Blvd.
Chicago, Ill. 1522 Michigan Ave.	Milwaukee, Wis. 18 Martin St.	New York, N.Y. 355 W. 57th St.	San Francisco, Calif. 116 Hyde St.

LAWRENCE PROCESS TRADE SCORED MARK CYLINDERS

Over 500 Licensee Representations Throughout the World.

L. LAWRENCE & COMPANY

Originators of Lawrence Scored Cylinder Process
Beware of Imitators

Home and Licensee Office:

292 Halsey Street NEWARK, NEW JERSEY

Repairs to Scored Cylinders by Lawrence Patented Process are permanent and guaranteed for the life of the motor.

Shop licenses obtainable. Write for particulars and prices today, as someone may be ahead of you.

Distibutors of De Luxe Light Weight Gray Iron Pistons, Rebco and Hi-Speed Rings and Wrist Pins.

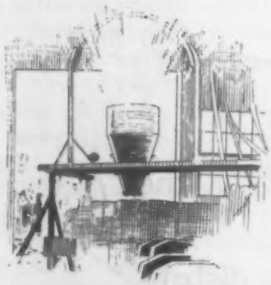
MEMBERSHIP
IN THE
AMERICAN WELDING SOCIETY
IS TESTIMONY
OF YOUR INTEREST IN
WELDING

SEND YOUR REQUEST FOR
APPLICATION BLANK TO

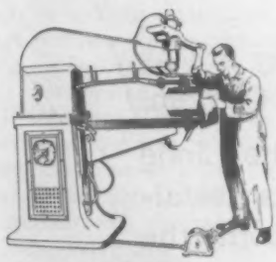
American Welding Society
33 West Thirty-Ninth Street
New York, N. Y.

FOR THE OXY-ACETYLENE WELDER

FOR THE ELECTRIC ARC WELDER



FOR THE THERMIT WELDER



FOR THE RESISTANCE WELDER

Send the Coupon Today

Order with this coupon enclosing check or money order for five dollars. If, after keeping the book five days for examination, you are not satisfied with it, you may return it at our expense and the purchase price will be promptly refunded.

THE WELDING ENCYCLOPEDIA, Second Edition, is the most complete compilation of welding information ever published.

No matter how much welding you do —
No matter what kind of welding you do —
No matter what welding process you use —

If you weld, you need this book

It describes in detail the theory and practice of every welding process.

It tells how to weld every weldable metal by each of the welding processes.

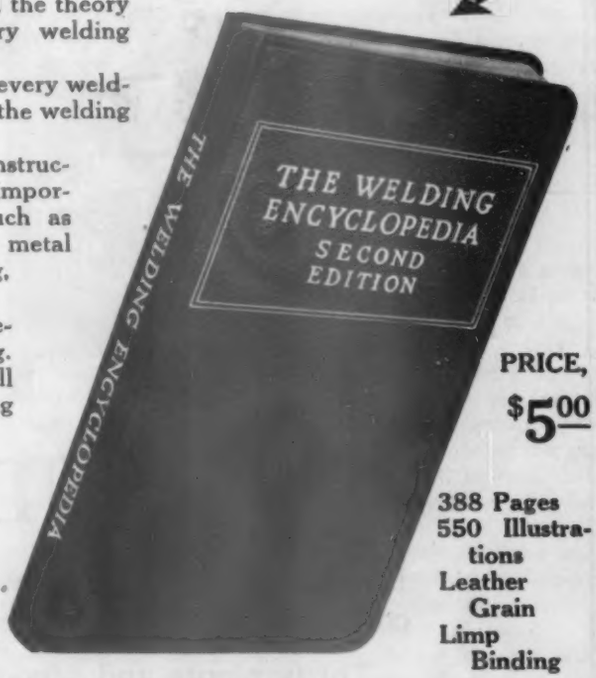
It gives detailed instructions for handling the important welding jobs, such as boiler welding, sheet metal welding, tank welding, pipe welding, etc.

It tells how to prepare parts for welding.

It tells how to install and care for welding equipment.

It explains the meaning of all words and terms found in welding literature.

It tells where to buy all standard makes of welding apparatus and supplies.



PRICE, $5.00

388 Pages
550 Illustrations
Leather Grain Limp Binding

FOR ALL WELDERS

CONTENTS

1. Illustrated encyclopedia covering all words, terms, and trade names used in welding.

2. Oxy-Acetylene Welding.—Aluminum, Steel, Cast Iron, Copper, Brass, Bronze. (Full instructions for welding each of these metals.)

3. Electric Arc Welding.—Complete instructions for welding all metals, studding, cutting, etc.

4. Electric Resistance Welding.—Includes Butt Welding, Line Welding, Percussion Welding and Spot Welding.

5. Thermit Welding.—The most complete treatise on this process ever published.

6. Boiler Welding.—An important subject for the welder to study.

7. Complete chapters on Pipe Welding, Rail Joint Welding and Tank Welding, explaining procedure in detail.

8. Heat Treatment of Steels.

9. Rules and Regulations.—What can be welded, and what cannot be welded. Rules also govern the installation and operation of equipment.

10. Charts and Tables.—A fund of welding information at a glance. Includes color chart showing colors at various temperatures, and color chart showing proper adjustment of oxy-acetylene welding flame.

11. Condensed Catalogs.—Up-to-date information about the leading makes of welding apparatus and supplies. The Buyers' Index is a convenient and reliable guide to the man who purchases or recommends welding apparatus.

4

The Welding Engineer Publishing Co.
608 S. Dearborn St., Chicago, Ill.

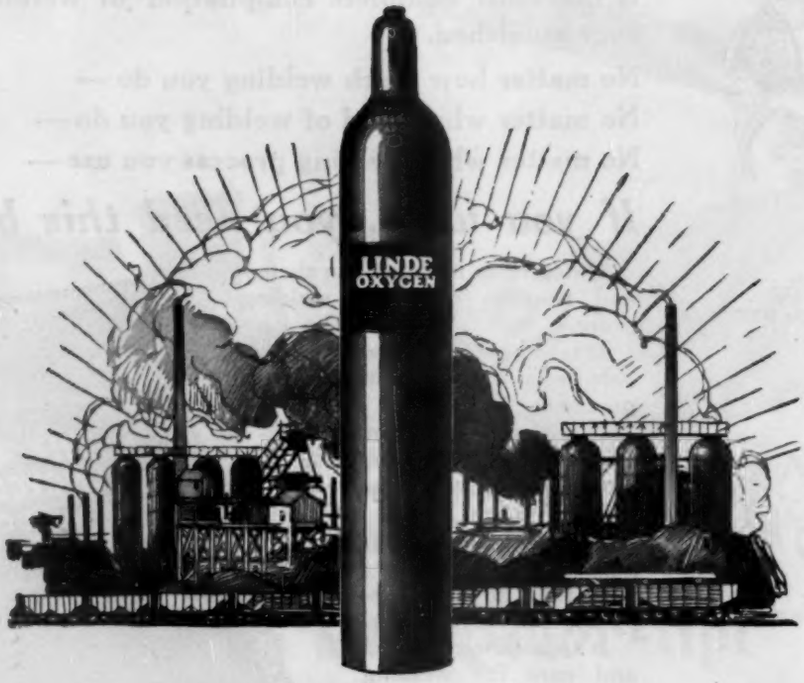
Gentlemen:

Please send me a copy of The Welding Encyclopedia, Second Edition, for which find enclosed five dollars. I understand that I may keep it for five days for examination and if it is not satisfactory I may return it and you will refund the purchase price.

Name .....

Street .....

Postoffice .....



DEPENDABILITY

Linde Service reaches every nook and corner of the country promptly and effectively.

Thirty plants and fifty-six warehouses form a distributing system capable of meeting any emergency without waste of time or motion.

Linde deliveries may be depended upon. They are as reliable as the uniformly high purity of Linde Oxygen.

It is because of these truths and because the Linde organization is constantly working to enlarge its usefulness and improve its service that Linde has become the largest producer of oxygen in the world.

No oxygen user, large or small, should close an arrangement for oxygen supply without first securing 1922 prices from the nearest LINDE District Sales Office

THE LINDE AIR PRODUCTS COMPANY

Carbide and Carbon Building, 30 East 42nd Street, New York

District Sales Offices in these cities: *Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dallas, Detroit, Kansas City, Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco*

THE LARGEST PRODUCER OF OXYGEN IN THE WORLD

SPECIAL USES FOR PREHEATER

The Preheating Torch Can Be Used for a Variety of Emergency Repair Jobs Around the Welding Shop

By J. H. Clemmency*

MUCH has been written upon the subject of Thermit welding and its remarkable value in effecting economies in time and money in repair work; yet it would seem that another phase of the whole matter has been neglected in its possibilities for great usefulness to those engaged in repair or miscellaneous machine work, and that is the varied uses to which the preheating torch may be applied in time of need. Of course the preheating torch of the Thermit welding outfit is considered but auxiliary equipment, designed primarily to produce conditions for a perfect weld, but the outfit had not been long in our shop before we had discovered a great variety of uses for it.

The preheater itself is so simple in construction and so compact that it may readily be moved about from place to place to whatever point it may be necessary to apply heat. In a machine shop, especially one engaged in miscellaneous repair work, it very frequently becomes necessary to obtain an intense heat in a hurry and to apply it at certain definite points and we have found, since we have had the preheater of the Thermit welding outfit added to our equipment that this has entirely supplied our requirements in this respect.

In describing some of the uses of the torch in our shop, the desire is to suggest to others who may have the preheater among their equipment, various ways to turn it to account in the manifold needs that arise in the average machine shop, and to show to those who do not possess one, how easily it might prove to them a great labor-saving device.

An unusual task that clearly illustrated the value of the preheater was the straightening of a 7½-in. dia. steel piston rod which had met with an obstruction in the cylinder of one of the large pumping engines of our system. The rod had a short bend just at the shoulder point at the large end of the taper, and the end of the rod was thrown out about ½ in. from center. A careful examination at the point of the bend revealed no trace of a crack or flaw, so we decided to straighten the rod, and replace it in service.

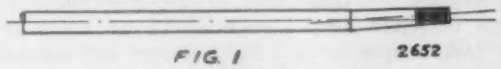
There is nothing remarkable about straightening a bar of steel of this size (any good smith with a large-sized forge or heating furnace could easily handle it), but when the operation is complicated by the fact that the rod to be straightened is a finished shaft, that no hammer or sledge blows may be permitted, and that the rod must be absolutely true when finished, it represents a fine achievement when the latter result was easily obtained by the aid of the preheating torch.

In straightening the rod we suspended it in a heavy 36-in. lathe, supporting one end in the chuck and resting the rod firmly on steel blocks built up from the ways of the lathe, at a point just back of the band. The lathe steady rest was used to centralize and steady the rod a foot or two back of the blocking, as shown. Just under the point of the bend, we supported a piece of sheet iron, and upon this, using old discarded fire brick from our furnace lining, we built an improvised furnace just around the bend, covering the top with a piece of sheet iron. In the front and just below the center of the rod we left an opening into which we introduced the burner of the preheater.

A heavy V-shaped clamp was hung over the end of the rod with two stud bolts passing through the ends of the clamps and down between the shears of the lathe and through a heavy cross-clamp that spanned the width of the lathe bed underneath.

When the torch was lighted, the flame, confined by the fire bricks at just the proper point, swept around the rod and speedily brought it up to a bright heat. Two wrenches were applied to the nuts on the clamp stud bolts, and the bent end was gradually pulled back to its original position—the center of the tailstock furnishing as a guide to determine the proper position.

When the blocking and clamps were removed, it was only necessary to take a very light cut over the tapered portion of the rod to insure perfect fit and alignment to the piston. The ease with which we handled this awkward piece of work was due exclusively to the fact that we were able to bring the



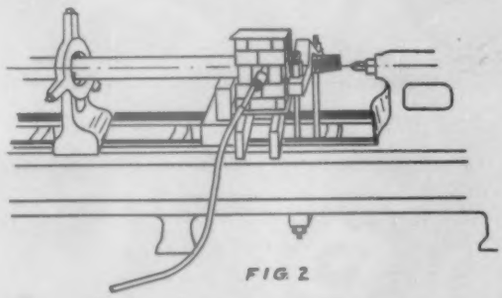
How the Piston Rod Was Bent.

Thermit preheating torch into play on the job at a great saving in trouble and expense. This job is typical of many others, wherein the convenience and power of the torch helped us over many a difficult problem.

It would be impossible to more than suggest a few of the uses of the preheating torch. Its possibilities are almost unlimited, and each user can develop its uses according to his own particular requirements. However, some of the general applications may be discussed, and it will be seen that any average machine shop could easily find constant use for one of these convenient heating torches.

In the general work of assembling miscellaneous machine parts often the application of heat facilitates the operation. Tight fits are easily negotiated and shrink fits accomplished by means of the clean, hot flame of the preheater.

Dismantling old machinery for the purposes of repair is frequently attended with difficulty—the different parts corrode together and often there are stubborn bushings to remove.



Set-up for Reclaiming Bent Rod.

The flame of the preheater is the magic wand that breaks the grip of age and corrosion, loosening up old parts and enlarging rings and bushings so that they may be readily removed.

In our wide range of babbitting work the preheater is again called upon to serve. In no other way can old babbitt be removed so rapidly and so conveniently as with the preheater. We stand a row of bearing shells in a line over a metal receiver and pass the flame of the preheater from one to the other, melting the babbitt linings out in a few minutes. Large shells and bearings may also be preheated before pouring babbitt, by the use of the torch.

When cracks develop in cast iron cylinders and chambers that are to be welded with the acetylene torch, the preheating that is so essential may most conveniently be accomplished with the aid of the preheater.

Once a resourceful and ingenious member of our organiza-

*Superintendent of Repair Shops, Bureau of Water, Philadelphia.

tion, having a number of large rivets to drive at a distance from a forge, and with no portable forge at hand, arranged a few fire bricks on a piece of sheet iron and improvised an oil-burning furnace by introducing the torch of the preheater into one side of the front, which had been left open; the flame swept around the enclosure and very neatly and quickly heated the rivets to the required degree.

We are quite prepared to discover other and valuable uses for our preheater as the future may bring new problems in repair work for us to solve, and we would not care to be deprived of its use for any consideration.

Kerosene is used for all heating operations with the exception of preheating for Thermit welds, when we invariably use gasoline.

LIQUID OXYGEN AS AN EXPLOSIVE

By E. H. Smith*

LIQUID air is a peculiar substance to the uninitiated. It will freeze mercury or burn steel, it will make ice cream in the wink of an eye, or blow up a stump with the same ease.

Liquid oxygen is commercially produced by the fractional distillation of liquid air. Liquid air as we know is produced by compressing air to a high pressure and expanding it rapidly, during which process it becomes intensely cold (194° C), at which point liquefaction takes place. This liquid air is composed of 21 per cent oxygen and 79 per cent nitrogen the same as ordinary atmospheric air, and it was discovered that by allowing a quantity of liquid air to evaporate slowly, it became increasingly rich in oxygen. This is due to the fact that the nitrogen is more volatile and evaporates first,

A Liquid Oxygen Explosion in the Open.

leaving the liquid oxygen in a more or less pure state. It remains then to design an apparatus to make this process continuous, which has resulted in the modern rectification columns of the liquid air oxygen plants.

While liquid oxygen itself, will not burn it is very active in producing rapid combustion when mixed with combustible material, as for instance wood charcoal. Wood charcoal at 0° C. will absorb 18 volumes of oxygen, but at the temperature of liquid oxygen it will absorb 230 volumes of oxygen. This property of absorption enables the production of a very high degree of vacuum. What I wish to point out is the explosive property of a mixture of powdered charcoal and liquid oxygen.

During my recent trip abroad I came in contact with the uses of liquid oxygen as an explosive, and saw the large containers used in transportating liquid oxygen. Some of these resembled an oil tank wagon, and I was naturally interested in carrying on some of these experiments in this country. From the knowledge I had gained I proceeded as follows: I took ordinary wood charcoal, powdered it finely, placed it in a linen sack about three and one-half inches in diameter and fifteen inches long, and fastened a dynamite fuse without a percussion cap in the end of the sack. Then I had a hole prepared under a fourteen inch oak stump and after submerging the sack of charcoal in liquid oxygen for approximately two minutes until ebullition ceased, placed it hastily in the hole, tamped it firmly with earth and lit the fuse. In approximately 45 seconds the explosion took place, which was very similar to that produced by dynamite, although as the photograph shows the stump was entirely re-

What Liquid Oxygen Did to a Stump.

moved and the roots so shattered that it would require very little additional work to remove them completely.

There is a further advantage in the use of liquid oxygen for blasting, due to the fact that in 20 minutes the liquid oxygen would have entirely evaporated, leaving nothing but inert charcoal and thus the danger of unexploded charges entirely eliminated. Very little has been done in this country in developing the use of oxygen as an explosive, but it is a subject well worthy of consideration.

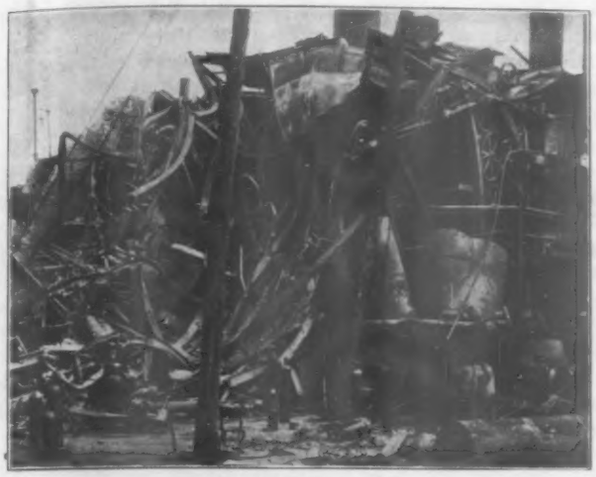
During the war when high explosives were unobtainable in Germany, liquid oxygen was made use of to a large extent in the destruction of bridges, fortifications and even used in shrapnel shells. I believe that liquid oxygen can be manufactured at a price competitive with other explosives for certain classes of work, and no doubt experiments along this line will rapidly develop and increase the consumption of this commodity. Other substances such as cork, sawdust, salt, etc., may be used in place of charcoal and future experiments may develop in even more powerful action. What the future holds in store for us along this line, can only be proven by careful and accurate experiments.

*President, Smith's Inventions, Inc.

SALVAGING REAL ESTATE WITH A CUTTING TORCH

The use of the oxy-acetylene cutting torch for cutting on production work, and for reducing scrap to sizes which can be handled, has become very well known in all of the metal working industries. Once in a while an unusual application of the cutting torch is found, and thus furnishes additional evidence that it is an indispensable tool. One of these unusual cases from recent experience was the salvaging of a valuable piece of ground, which probably could not have been cleared in reasonable time by any other process. In this case a large factory had been completely destroyed by fire. There was an unusually large amount of structural steel in the frame work of the building, and some of the machinery was large enough to extend up through three stories. The fire secured such a good start that it was impossible for the firemen to do more than prevent it from spreading to adjacent buildings. Practically every ounce of combustible material in the building was burned, leaving behind a big pile of twisted I-beams and warped machinery. One of the illustrations here shows a small corner of the wreckage after more than three-fourths of it had been moved away. The other illustration is a close-up view of the cutter working on one of the twisted beams. The second illustration gives a good idea of the intensity of the heat which must have prevailed.

In this case the steel structure and the machinery had been twisted and melted together to such an extent that it would have been impossible to have moved the wreckage away without cutting it up into small pieces. It was situated on a piece of ground which was badly needed for continuing the manufacturing activities, and the owners of the building were desirous of erecting a new structure at the earliest possible date, so that production could be continued. A part of their regular equipment was a



One Corner of the Wrecked Plant.

portable oxy-acetylene welding outfit, and the welder being familiar with the possibilities of oxy-acetylene cutting was able to guarantee that a cutting torch would go through that pile of scrap in short order. To get it done in the shortest amount of time, he secured a crew of five oxy-acetylene cutters who were put on the job, and an extra supply of acetylene and oxygen was rushed to the spot These men started at one corner of the old factory site and proceeded to work toward the other corner, cutting off pieces small enough to be lifted and carried by eight or ten men. Box cars were backed up on a switch adjoining the factory, and a crew of men were kept busy carrying the pieces out and loading them on the cars as fast as they could be cut loose from the pile. The metal was so tangled up and there were so many pieces to be cut in different positions, that it was impossible to secure the speed and efficiency which might have been possible on straight cutting. The cutters were obliged to climb through the pile and drag the hose with them into out of the way places, then, after making a short cut, were obliged to move on to some other equally difficult position. This accounts for the fact that it took five men five days to make a complete job of reducing the wrecked building to scrap sizes small enough to be handled and loaded on box cars.

There was very little of the structure which could be salvaged for future use. A few of the large rolls were in usuable condition, and a good many of the gears, but otherwise the machinery was practically ruined. Some idea of the amount of cutting which had to be done can be gained from the fact that the big pile of ruins shown in the first photograph comprised only about one-eighth of the entire wreckage. This required cutting enough to consume about 100 cylinders of oxygen and about 20 cylinders of acetylene. The only other methods which could have been used to clear the ground would have been man cutting or blasting. Both of these would have been far more expensive, and would have taken a good deal longer time than the cutting torch required.

While this work was in progress an unusual application of oxy-acetylene welding occurred, as the result of what might have been a very serious accident. One cutter was working on a heavy steel member, which unknown to him was being cut through by another torch. When it gave way, the unfortunate chap slid about fifteen feet and crashed against some of the steel ruins below him. He heard something snap and told his fellow cutters that his leg was broken. One of them picked him up and helped him hobble to a welding shop nearby, where a cutting tip was replaced by a welding tip and he proceeded to weld his own leg. This piece of surgery was entirely successful, and he was back on the job in thirty minutes after the accident occurred. The oxy-acetylene process is not universally recommended as a surgical instrument, but in this case the operation was made possible by the fact that the cutter had broken his wooden leg instead of his own leg. The steel hinge which gave way when he fell is still giving good service.

Close-up View Showing How Badly the Fire Had Twisted the Steel Structure.

Acknowledgment is made to Mr. Geo. D. Purdon, of the Commercial Acetylene Company, and Mr. E. D. Findlay, of the Acme Oxygen Company, for co-operation in supplying photographs and information regarding this interesting cutting job.

THE WELDING ARC AND EYESIGHT

The Influence of the Arc on the Eye Has Never Been Known to Cause Permanent Injury or Loss of Vision

By C. J. Holslag*

SOME writers on welding topics have considered it perfectly legitimate to circulate propaganda to the effect that the rays of electric arc will cause discomfort and even harm to the naked eye. This may be their candid opinion without accurate knowledge, but when sincere friends and advocates of arc welding begin to give credit to unfounded statements concerning permanent injury to eye-sight caused by the metallic welding arc, it is imperative that something should be done to stem this landslide of misinformation. In fact, this mass of rumor has recently grown to proportions far exceeding any foundation of truth it may have been based on. It seems very much like the report of Mark Twain's death, which he said he considered greatly exaggerated.

It is true that anyone who looks directly at the metallic arc will suffer discomfort, but the annoyance, if not aggravated, will be of but very short duration. As far as the writer knows, there has never yet been a case of permanent injury to the eyes due to this cause.[1] All such reports of blindness have, for the last ten or twelve years, been diligently investigated, with the result that those which could be traced to their sources were found to have been based on vague rumors.

There are probably no two more eminent authorities on arc welding than Mr. Elihu Thomson, of the Thomson Electric Welding Company, the father of the electric welding industry, and Mr. W. F. Andrews,[2] of the General Electric Company. It is significant that both of these recognized specialists, in a recent consultation, agreed that in all their extensive experience, they had never noted a case of permanent injury to the eye-sight from any form of the carbon or metallic arc.

Possibly there is some basis for the public opinion that blindness results from a too close inspection of the arc with the unprotected eye because discomfort of course is the result. But if these reports of blindness are traced, they soon drift off into the indefinite, "Someone told me," in which the "someone" never appears, or, possibly, an original case of poor eye-sight is found to have been charged to the electric arc. There was actually a case on a railroad, in which a man, cross-eyed from birth, attempted to blame his abnormality on the arc when he was discharged for incompetence. On the other hand, I have heard reputable people voluntarily state that the arc was good for the eyes, and actually strengthened their eye-sight.

The writer's personal experience is an interesting case in point. Eighteen years ago the medical advisory board in college told him that his eyes were weak, and that he would need glasses soon. Since then he has probably been "flashed" a thousand times, and the glasses are still unnecessary. Of course the arc will not cure a case of strabismus, or cross-eye, but it actually appears to be of some service to the eye because it exercises that organ in becoming accustomed to the replacement of the vital pigment which is evidently destroyed by the arc when viewed without adequate protection.

This replacement of the burnt-out pigment or tissue is the cause of the discomfort of one who has been "flashed," or, in other words, been exposed for an appreciable time to the full glare of the electric arc. The process of replacement lasts about fifteen or twenty minutes, after which no further annoyance is experienced. If every operator who became "flashed" were serene in this knowledge, and could simply abide the discomfort for a short time, his troubles would be over. However, the general method is to become panic-stricken, and apply all sorts of foreign substances to the eyes, from tea-leaves to quids of tobacco. Of course, these substances only cause added irritation, and the complications that ensue may result in permanent injury.

The proper way to handle the "flash," based on the writer's broad experience, is as follows:

If, inadvertently, or through deliberate ignorance, the arc is viewed directly, there is no immediate discomfort. Sometimes several good, direct looks may be taken, and even old-timers, because of their contemptuous familiarity with the arc, are apt to do this. Then, about four hours later—usually after night has fallen—lights begin to appear as though seen through a heavy yellow fog. The reason for the appearance of the symptoms at night, though the subject may have been "flashed" early in the morning, is that the pupils are dilated at night or in dark places. The proper thing to do when this first symptom is felt, is to go to bed and go to sleep, when one will awaken next morning with eyes perhaps a little weak, but with no discomfort. However, if one does not go to sleep at the appearance of these symptoms, they will, in a short time, result in the feeling which is 100 per cent graphically described as "sand in the eyes." Sleep is now out of the question, and the sufferer must bear it like a man for fifteen or twenty minutes. The best thing to do is to leave the eyes alone, although it is permissible to apply a weak solution of boracic acid with an eye-cup (*not* with a cloth), and after a time the discomfort will dwindle away. Great help in bearing it is found in keeping among bright lights with one's eyes open, after which sleep will do the rest. If, however, all sorts of remedies are applied, the eyes will become irritated and inflamed, and the discomfort may continue for several days.

The remedy for all this is perfectly obvious, but advocates of arc welding find they have deep-seated prejudices to combat. Once the enlightenment becomes universal, there will be no more case of aggravated discomfort, or even "flashing." The sun has circled the heavens since the world began, yet one direct look at it might blind a person for life. The same analogy is applicable to the arc. Do not look directly at it with the unprotected eye, or with a thin smoked glass. Unfortunately, the sun effect is more familiar than the arc, and so does not attract so many curious glances.

The arc has two effects on the eye; first, the intensely white light which dazzles it, and, second, the ultra-violet rays at the invisible end of the spectrum, which the arc emanates in abundance. These latter rays are the ones responsible for the destruction of the pigment already mentioned. Any glass, whether plain or colored, will be effective in deflecting the ultra-violet rays, but a glass of dense color is needed to substract enough of the dazzling white rays for the eye not to be fatigued. To a much lesser extent, because it is not so intensely bright as the arc, the same is true of the gas welding flame.

The skin pigment, wherever closely exposed to the arc will be destroyed by the ultra-violet ray in much the same manner as in sunburn. As in sunburn, if the burns are light, ordinary remedies will suffice; if heavy, medical attention is necessary. For adequate protection, a little common sense is all that is needed. Although death has resulted from severe sunburn, the sun is not only regarded as beneficient to the planet, but is scientifically held as responsible for the continuance of life. To a lesser extent, but in the same manner, the welding arc is a valuable aid to many industries, and must be treated as such with simple respect of its powers.

For the protection of the skin, dark, heavy-cloth gloves should be used, and the shield or helmet used to protect the face should be sufficiently enlarged to mask the sides of the face. A simple

---

*Chief Engineer, Electric Arc Cutting and Welding Co.

[1] *See "Protection of Operators," Welding Encyclopedia, Second Edition, page* 160.

[2] *See "Eye Protection," Welding Encyclopedia, page* 68.

shield, which cuts off the direct rays of the arc, is not sufficient where light walls may reflect behind it.* A helmet or mask with side protection is essential for keeping the eyes from tiring. Many welding jobs are curtailed, or actually discontinued because reflected light from an adjacent operator annoys another who clings to an antiquated shield the size of a hand mirror. It has been the writer's fate to have continual dissensions with operators who consider themselves clever enough to use these diminutive shields, but eventually the more intelligent ones adopt the helmet or shield which actually protects. Moreover, in a helmet which does not have to be held with one hand, both hands are free for more efficient work. Many operators quit the game because they are deficient in the steady, common sense mechanical instinct required by arc welding.

The glasses which are inserted in the helmet for viewing the arc may suit the fancy of the operator, but the general requirement for a glass is that it be effective in eliminating the ultra-violet rays, and in possessing a color dense enough to cut down the dazzling visible rays. Hence any dark glass is more or less serviceable if it allows the molten metal to be observed.

Thickness will make little difference in the use of flashed glasses, but it is usually desirable, inasmuch as a more even color and density may be obtained thereby. Moreover, the exact color of the glass is not a vital factor, but the writer has found that combinations of green and red give the most life-like appearance to the molten metal under the arc.

Unfortunately, the correct density of a glass for one class of work may be incorrect for another. For one may imagine that the arc at ten amperes draws less power than at a thousand, with corresponding variation in brightness. To overcome this, however, it is not necessary to resort to more than three glasses, if they are of the proper color. Various combinations of a medium green, a dark green, and a dark red have been found to satfactorily cover all variations. The following approximate table will suffice to show how the colors are combined:

10 amperes.....medium green.
100 amperes.....dark red.
200 amperes.....dark red with medium green.
350 amperes.....dark red with dark green.
600-1000 amperes.....medium and dark green, with dark red.

There are on the market special makes of glasses for arc welding, each of a single density. By carefully selecting the proper density, one may purchase a glass of this type that will be suitable for a given brightness of the arc. For general work, however, it would be necessary to purchase a set of these glasses of varying densities, whereas the three-color system described above is seen to be much simpler.

Promoters of these special lenses are at great pains to instill a certain amount of mystery into their product, asserting that these lenses contain secret elements essential to eye protection. This is rather amusing to the older welders, who have used ordinary colored glasses for years before these benefactors came to their rescue. It has long been standard practice on railroads to utilize their ordinary signal glasses for this purpose. As a matter of fact, all that is really necessary is to choose a glass that contains no white spots nor variations in color density, and glasses so chosen are, in the opinion of the writer, just as satisfactory as the highest-priced welding lens yet produced. Of course, in the case of fastidious operators, there is a psychological advantage in the use of a nicely finished lens imported from Belgium, and this may increase production sufficiently to justify such preference.

To save a good lens, and to prevent flashed lenses from spotting, a plain piece of thin glass should be inserted in front of the better lens. This receives the unavoidable sparks which fuse into the glass when welding close to the work, which is essential where good results are required. Every operator knows that close scrutiny of the work is necessary; in other words, one must put his nose right down to the work to see where the metal is going.

Protection for adjacent operators should be provided by screening off the welding. For temporary locations, portable screens of wood or canvas painted black may be used. These screens are similar to the familiar household ones, and may be set up anywhere. For permanent locations, booths of wood, metal, or canvas hanging from a framework of piping may be used. The latter construction is ideal if the canvas is allowed to hang clear from the floor about two or three feet, so that the work may be pushed in and out of the booth with facility. In foundries and shops such as railroad shops, having hoist or cranes, a grounded hand-car on rails may be pushed out and under the crane to receive and discharge heavy welding jobs.

In closing, it will not be remiss to again emphasize certain facts in connection with the question of the effect of the arc on the eyes. The writer is unhesitatingly prepared to go on record with the statement that the rays from the metallic welding arc have never permanently injured human eyesight, and, moreover, he defies anyone to produce a case disproving this belief. Finally, the writer hopes that this little discussion will be of some value in alleviating the discomfort and apprehension of the actual "flash," but, more especially, he hopes that he has succeeded to some extent in replacing mere hearsay with actual facts concerning the behavior and effects of the arc.

*See "Protection of Workmen," Welding Encyclopedia, Second Edition, page 160.

REPAIRING CYLINDER BLOCKS

By Geo. E. Strong

Two of the most interesting jobs which we have handled recently were on Oakland cars. In both cases the connecting rods were broken and came out through the side of the cylinder block just at the base of the cylinder. The first one broke out a hole about 5 in. in diameter, and the broken piece was split into four parts. We did not want to remove the motor from the frame and preheat, so we put the broken pieces back into place and brazed them. The job was not entirely successful the first time because two small checks developed, but when these were V'd out and rewelded the job turned out satisfactorily.

In the second case the broken piece was at least 6 in. in diameter, and was lost entirely. We took a piece of ¼ in. boiler plate, a little larger than the hole, and placing it on the inside of the block marked the exact shape of the break. In this manner a patch of the right size and shape was cut and ground to suit the job. We cut it small enough to leave ⅛ in. clearance all around, and then used a bronze filler rod. This enabled us to do this job without preheating or removing any part of the motor from the frame, and in this case there were no checks in the job when it cooled. In making this second repair we brazed about one-third the way around the patch, and then stopped. We then took a steel brush and kept brushing across the weld until it had cooled enough not to burn the hand. The same procedure was followed on the other two-thirds, and it turned out to be an oil tight job at the finish.

I think the brushing had a tendency to help distribute the heat to some extent, making the contraction a bit more uniform, and giving the bronze a chance to stretch evenly. We have tried the same procedure on several cast iron jobs since, and it seems to work very well. The points we are particular about are to have the parts absolutely clean, and to be careful not to heat the cast iron above a cherry red.

The Norwalk Iron Works Company, pioneer builders of compressors, manufacturing air and gas compressors for all purposes and also refrigerating machinery, with general offices and works, South Norwalk, Conn., has just opened a Chicago office.

It is located at 627 W. Washington Boulevard and is in charge of L. R. Bremser, who for thirteen years was associated with The Gardner Governor Company. He is thoroughly familiar with all angles of the compressor business.

RECOLLECTIONS OF A SALESMAN

A Few Instances of Attempts to Mix Oxygen and Oil Indicate That Not Enough Attention Is Paid to Safety Rules By the Users

IT seems only recently and surely, it cannot be a very long time ago, that it was nip and tuck for big business,—and close competition all around. But there was plenty of demand and all that was needed was a big enough source of supply. Now it is the other way. The supply is big enough, but the demand doesn't seem to match it and we are all on our tip-toes gathering in the loose ends and making every little prospect count.

Of course, selling welding and cutting apparatus and supplies is no different from selling any other line. The same route, the same faces, the same line of talk, and once in a while the same sort of demonstration. But unusual incidents were also in order, and these helped to enliven those moments when we were harassing our customers for more business and at the same time endangering our lives,—although the latter statement may appear exaggerated.

The Service Man Didn't Wait to See How This Combination Worked.

One of my first interesting experiences occurred in a small welding shop where the welder had early appreciated the value of a preheating system which he could control as to intensity or locality of application. But instead of purchasing one of the many commercial products he had arranged for himself out of some scrap pipe and a sheet metal container a very serviceable looking affair. The air pressure he obtained from a cylinder which he charged at a neighboring plant where a high pressure line was in use. For many months I had called on him, and invariably I had noted that the preheater was operating in a most satisfactory manner. But this particular morning of which I am about to relate, the preheater had not yet been started although preparations were under way and several jobs were awaiting the application of heat. One look was enough and I was on my way.

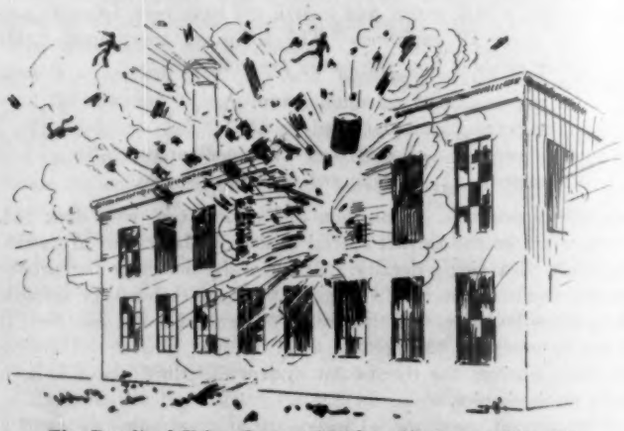
As I was enlightened later, the factory at which the air cylinder was charged had shut down temporarily. The air cylinder being empty, somebody had conceived the brilliant idea that an oxygen cylinder would serve the same purpose. Without careful forethought this genius had connected the oxygen cylinder in place of the air cylinder and would have turned on the pressure had I not been able to dissuade him temporarily, while I explained the dangerous consequences that might ensue. He was difficult to convince but finally decided to listen to reason and did his preheating with charcoal until his source of air was again available.

At a scrap-yard which I also visited quite often was a small portable pressure acetylene generator for use in cutting steel scrap to charging box size. For several weeks the owner had been complaining about faulty operation and I was sent to investigate. I left my hat and coat in his office intending to examine and repair the generator immediately, but, as I later expressed it, I didn't even stop for my hat and coat on the way out.

The generator was in operation when I observed it, but the relief valves had all become faulty and the pressure in the generator had mounted to the highest point registered on the gage and was unnoticed or probably ignored by the operator. Possibly he had never been instructed to the effect that acetylene was dangerous at 30 lbs. per sq. in. and over. At any rate I felt rather squeamish about fooling with the generator and was much relieved when I had set the valves and put the generator in proper working condition. And then the operator was given a lesson in generator handling that he will never forget any more than I can forget the shaky feeling I had while adjusting this piece of apparatus.

At another time a phone call to the office called me out to where "200 feet of 2½ inch pipe had blown out and four men gone to the hospital." Here was a pretty piece of damage caused by gross carelessness and lack of forethought.

This plant was using a large capacity generator, but found the pressure insufficient, and had installed a rotary booster. The oil used in lubricating the booster had gradually been pumped into the acetylene supply line and had been carried to the various station regulators and torches. Naturally the torch operation was faulty and inefficient. Somebody had suggested cleaning the pipe line with pressure. So all the outlets were closed, and a full oxygen cylinder connected to the acetylene pipe line. The intention was to create a pressure by turning on the full oxygen pressure and then opening the outlets to expel all foreign matter. It worked. Not only did it clean out the foreign matter,—it cleaned out practically the entire pipe line, part of the side of the building, and sent four men to the hospital, although no one of them was seriously injured. What would anyone expect of such a combination—oil, acetylene and oxygen in an enclosed space under pressure?



The Result of Using Oxygen to Blow Oil from a Pipe Line.

I have noted several serious explosions in oxygen regulators and as far as I know, no logical explanation has been offered for such occurrences. From noting the conditions and the attending circumstances I have come to the conclusion that such an explosion occurs only when the oxygen pressure has become very low and the acetylene is used at a fairly high pressure. Careless handling of the torch causes a backfire and the acetylene follows the oxygen up through the hose into the regulator where an explosive mixture results and ignites.

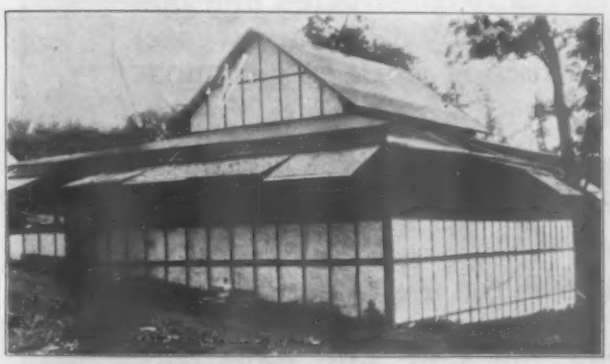
Once or twice it has been necessary to examine accidents where regulators have blown up when not in use. These have all been due to some person unacquainted with regulator design attempting to repair faulty operation of the apparatus. One of these times the embryo repair man forgot to insert the hard rubber seat. Can you imagine the speed at which the cap traveled when the oxygen pressure was turned on?

The whole matter may be summed up briefly by a word of caution: "Leave well enough alone." If you are a welder or cutter, stick to your calling. Let the manufacturer build and repair your apparatus.

CAMP BUILT OF CARBIDE CANS

One of the most interesting by-products of the oxy-acetylene industry is a summer camp made from carbide cans. Mr. S. D. Winger, manager of the Gas Products Company, Columbus, Ohio, the originator and designer of the bungalow, is shown in the accompanying photograph. The camp is situated on the edge of a lake in northern Wisconsin in the heart of an excellent fishing and game country.

A standard Calcium Carbide can is 12 inches in diameter and 20 inches in height. By the use of an oxy-acetylene cutting torch, with a very small tip, both heads can rapidly be cut off. A cut is made down through the longitudinal lapped seam. By simply opening up the rolled section and standing upon it with one's feet, the corrugated sheet of metal can be easily and sufficiently straightened out. It will be found that a sheet of metal corrugated through its longest dimension and measuring approximately 38 inches long by 21 inches wide will have resulted. The corrugated sheets of metal, wired into bundles of 25 each, are then ready for shipping and form bundles not too heavy to handle.



The Carbide Can Camp.

In making the frame work for the camp, the 2x4-inch studding was spaced 19½ inches between centers. Horizontal spacers were run 36 inches between centers. The corrugated sections, just as they result from the cutting operation, are fastened with lath nails to the studding between the horizontal spacers, with the bulged side of the corrugated sheet out. Each sheet is lapped approximately ¾ inch over the next adjacent sheet, above, below and at the sides. The frame work is sheathed both inside and out, the dead air space between making the building either cool in summer or warm in the fall. Two coats of good white lead were given the completely sheathed structure. Ordinary building lath were first painted an attractive shade of green, and then applied over the ragged lapped edges of the sheathing metal. The roof of both the body of the structure and the verandas is ordinary 3 ply red flint roofing. The ceilings are of wall board. The shutters, which are hinged, are equipped with small blocks and tackles, making it possible to raise and lower them from the inside with but little more effort than raising a window shade. These shutters are wooden frames covered with 38x21-inch carbide can sections and battened with green painted lath, to correspond with the similar pannels in the body of the structure. The shutters act as awnings when the weather is pleasant and effectively keep out the rain and wind when the latter is coming over the lake on chilly days. The shutters make the whole veranda livable at all times, as furniture, rugs, fittings, etc., do not have to be moved within the structure in case of a sudden rain or wind storm. All verandas and windows are screened with small mesh, galvanized mosquito bar. In consequence, the various parts of the 60 feet of veranda, act as dining room, lounging room and sleeping quarters. One can really live out doors all the time with the above construction.

Those who did not know how the structure was built, called it Japanese construction and gave credit for an unusual and ornate design. Several inquired where they could get similar material for such construction. The small white pannels with the green battens are pleasing to the eye and unusual enough to be novel. The small amount of warp after the metal sections are nailed in place, is not noticeable, particularly when painted white. The small corrugations with the margins on either side suggest that the material was made in this way for ornamental reasons.

It would take a can opener or a cutting torch to get into the camp, when it is closed for the winter, as all windows and doors are covered by large carbide can shutters, similar to those on the veranda, and securely screwed into place.

C. H. DOCKSON HEADS NEW COMPANY

C. H. Dockson, formerly of the Weldit Acetylene Company, of Detroit, has sold out his interests in that company, and recently organized the C. H. Dockson Company at 161 E. Columbus Street, Detroit. Mr. Dockson is well known throughout the oxy-acetylene welding industry, both as a salesman and manufacturer of equipment. He was with the sales department of the Oxweld

C. H. Dockson.

Acetylene Company for about six years, up until five years ago, when he organized the Oxweld Acetylene Equipment Company, which was later changed to the Weldit Acetylene Company.

The new company plans to go into the manufacture of oxy-acetylene equipment on a large scale, with the intention of selling largely through jobbers, and will shortly be ready to allot territory to jobbers throughout the country.

WELDING AND CUTTING APPARATUS

Thousands of Users Sell REGO

The finest kind of advertising is done by REGO users.

Daily we get letters telling us that some experienced welder, or foreman, or superintendent who uses REGO has advised the writer to purchase.

If a satisfied user is the best kind of advertising—and we believe it is—then REGO apparatus is daily being boosted by an enthusiastic legion of REGO believers.

REGO torches are technically correct. They are constructed upon a principle scientifically sound—U. S. Patent No. 1,301,044—and they are carefully constructed in a factory with every modern machine, and by men trained carefully through many years of construction work on gas apparatus.

REGO torches eliminate the flash, use lowest pressures, materially decrease oxygen bills, and give a soft smooth flame, ideal for good welding.

The REGO torch is the pioneer in the use of a lower oxygen pressure. Its constructors developed this principle. It will—and does—have imitators, but why buy imitations which are inferior in construction and which cost at least as much and in some instances more?

The REGO line is complete. We have torches from $5.00 up. Regulators from $11.00 up. Complete units from $7.50 up. Acetylene generators from $175.00 up. Preheaters from $15.00 up. Our catalog illustrates and describes the complete line.

If you are interested in better welding, ask for 23W.

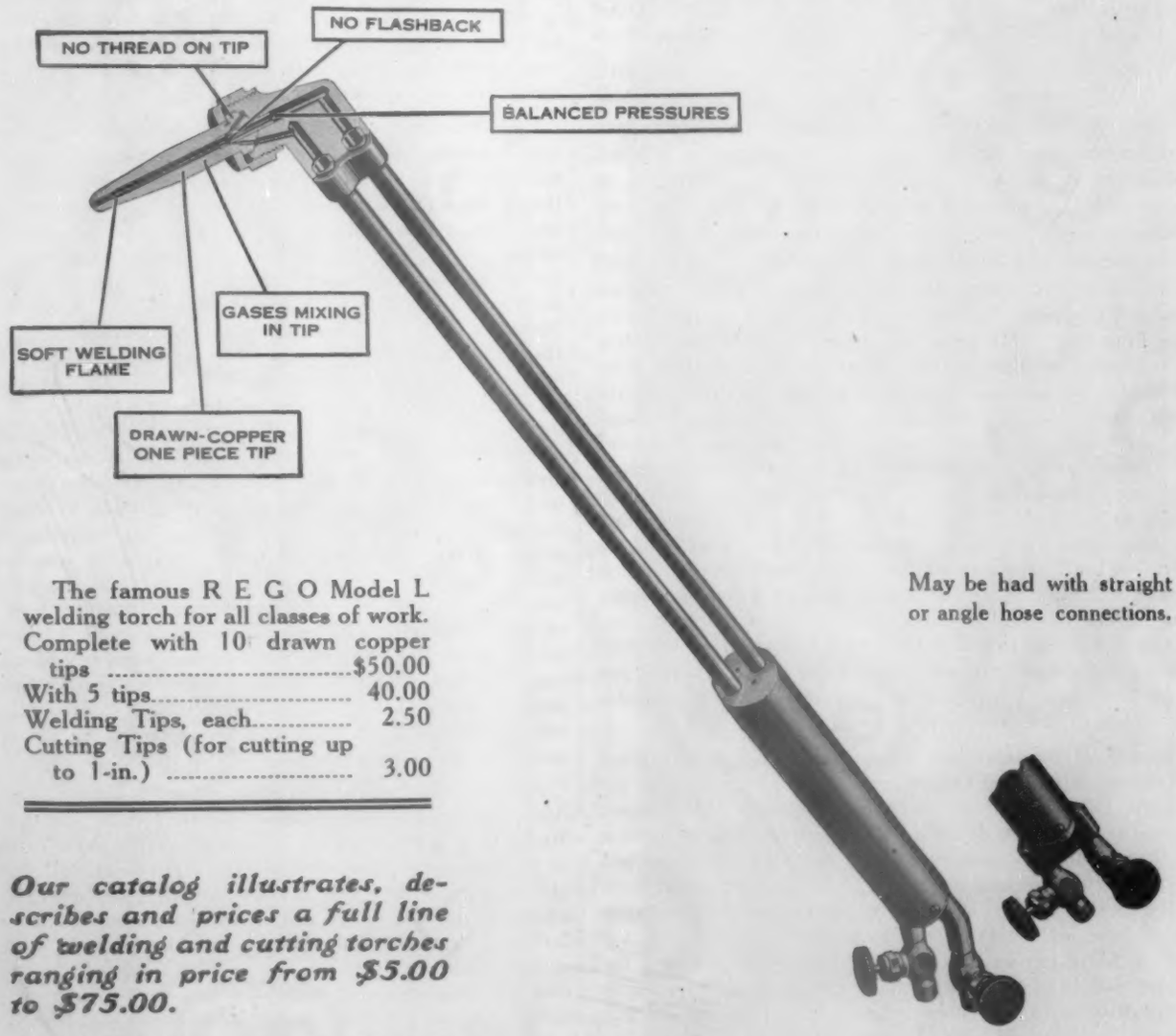
THE BASTIAN BLESSING COMPANY
WEST AUSTIN AVENUE AT LA SALLE STREET CHICAGO.

WELDING AND CUTTING APPARATUS

REGO "L" WELDING TORCH

For Acetylene (tank or medium pressure generator)

Many call this the "All-Purpose" torch, since it will handle every welding job from light sheet metal to heavy castings, and cutting up to one inch.
Measures 22 inches over all.
Furnished with ten (10) drawn-copper welding tips and one (1) cutting tip.



The famous R E G O Model L welding torch for all classes of work. Complete with 10 drawn copper tips $50.00
With 5 tips 40.00
Welding Tips, each 2.50
Cutting Tips (for cutting up to 1-in.) 3.00

May be had with straight or angle hose connections.

Our catalog illustrates, describes and prices a full line of welding and cutting torches ranging in price from $5.00 to $75.00.

ASK FOR CATALOG No. 23W.

THE BASTIAN BLESSING COMPANY
WEST AUSTIN AVENUE AT LA SALLE STREET CHICAGO.

THE INTERNATIONAL ACETYLENE ASSOCIATION CONVENTION

ONE of the most interesting and instructive events of the year for the Chicago users of the oxy-acetylene welding process was the Twenty-Third Convention of the International Acetylene Association Convention, which was held at the Hotel Sherman, October 25th to 27th. The Convention was well attended throughout, and the discussions of the papers were very instructive

Particular attention was given to the subject of safety in construction, installation and operation of acetylene generators and equipment. The industry as a whole recognizes that the industry must be safeguarded against fires and explosions. This was made the subject of a talk by Mr. S. J. Williams of the National Safety Council, an organization whose activities enable it to speak with authority on the enormous total losses which are of an avoidable nature. It is the desire of the Association as a whole and of its individual members, to surround the use of acetylene with all possible safeguards, and practical application of that spirit is found in close co-operation with insurance men and inspectors.

In the afternoon session of Wednesday, October 25th, Mr. G. O. Carter presented the report of the Oxy-Acetylene Committee. This report outlined the progress which has been made in extending the applications of oxy-acetylene welding, and looked ahead to a more intensive use of the process by the large industries which at present are using it on a comparatively small scale. This report was almost of a prophetic nature, and was backed up wonderfully by the next paper on oxy-acetylene welding as applied to oil carrying lines and pumping stations by N. H. Wagner of the Prairie Pipe Line Co. This paper described in detail the welding of 140 miles of pipe which carried oil at a pressure from 650 to 750 pounds per square inch. On the first test the entire line showed only one-half dozen leaks, although the work was done under very trying working conditions and in some places over a difficult country. It also developed that the washing out of this pipe line did not cause any breaks in the welds. The fact that this mammoth welding job was completed with practically perfect results is an indication that there was no limit to the possibilities of applying the welding process, provided the superintendent insists upon having thoroughly trained men to start the work, and does not hesitate to take them off of the job at the first indication that they are not doing good welding. This job would not have been possible without extremely careful supervision of the process itself.

The use of oxy-acetylene equipment in a city gas plant was the subject of the paper read by W. E. Lungren of the Western United Gas & Electric Company. This paper, like the one before it, described a very perfect job of welding pipe line, with this difference, that the pipe line described was to carry illuminating gas at a pressure of 150 pounds. In the discussion of these two papers, another instance of this kind of welding was mentioned. The third case was a welding job on a steam pipe line. This much of the meeting definitely established that welding is entirely practical and trustworthy for pressure pipe lines to carry oil, gas or steam.

The remainder of the afternoon was devoted to a paper by J. H. Dawson on the subject of cutting steel forgings. This paper was illustrated by micro-photographs showing the effect of heat treatment on the structure of the forgings. The object of the paper was to point out the advisability of cutting on hot metal whenever possible, because while good results can be secured by cutting cold metal, the resulting structure is a little better in the case of cutting it while hot.

The Thursday morning session was largely devoted to safety topics. Mr. A. R. Small, Vice-President of the Underwriters' Laboratories, explained the organization of the Underwriters' Laboratories, its equipment and its purpose Mr. Harry P. Cooper, Secretary of the National Association Mutual Fire Insurance Companies, presented a paper on the mutual fire insurance companies' opinion on the acetylene industry. He made clear to the members that the chief aim of the insurance companies was to reduce losses. He made it very plain that insurance companies are not antagonistic toward any heating or lighting device from any other point of view except the possibility of increasing the fire risk. This safety discussion was followed by a lecture by A. S. Kinsey, explaining a series of motion pictures to show the manufacture and uses of carbide, acetylene and oxygen.

On Thursday afternoon, the members were entertained at the plant of the Underwriters' Laboratories. The entire building was thrown open to their inspection, and they had an opportunity to witness the routine tests of fire resisting and fire fighting products, and incidentally, a number of very interesting special tests which the Underwriters' Laboratories were called upon to make.

Friday morning Mr. S. W. Miller presented on behalf of the Technical Committee, a paper showing the present status of the welding of pressure vessels. It was unfortunate that there was not a larger number of boiler makers represented in the attendance, because this paper certainly furnished an opportunity to get thoroughly acquainted with the actual status of boiler welding. The subject was further discussed by Mr. J. C. McCabe, State Boiler Inspector of Michigan, and Mr. Morrison of the Hartford Steam Boiler Inspection Service. There is every indication that insurance men and inspectors are willing to be perfectly fair toward all of the welding processes, as applied to boiler work, but they have constantly before them a few horrible experiences of the results of poor judgment, and they are not willing to give welding a clean bill of health until they are furnished with some method of testing, or some method of controlling the operator, which will give them some assurance as to the ability of the men doing the work. It is not a question of whether the weld can be made strong. It is rather a question whether the strength can be proven, and whether they can be assured that capable and conscientious welders are being used. There is evidently a long hard road ahead of the men who are trying to secure the approval of welding on pressure vessel work, unless satisfactory test methods and training methods are developed and accepted by the insurance men and inspectors.

Following the discussion of pressure vessel welding, Mr. Albert Sobey, Director of Education, Industrial School, Flint, Mich., read a paper on the co-operative training of welders in the automobile industry at Flint. The organized method of the big industries in the city of Flint to increase the efficiency of their workmen, might well serve as a model for local sections of the American Welding Society in developing some systematic method of training welders. The cost of this co-operative training is very low for the individual concerns, and the results secured in the way of having available a good supply of thoroughly trained workmen is very much worth while. This paper pointed out very clearly a really practical way by which the efficiency of welding operators in large industrial centers can be raised.

Friday afternoon session of the Convention was devoted to oxy-acetylene house lighting topics. The Convention closed with an exceedingly successful banquet in the Tiger Room of the Hotel Sherman.

INSPECTION OF UNDERWRITERS LABORATORIES, INC., CHICAGO. INTERNATIONAL ACETYLENE ASSOCIATION. OCT. 26, 1922.

1—C. R. Alling; 2—S. B. Kirk; 3—J. F. Merrington; 4—G. D. Stone; 5—J. R. Dawson; 6—B. S. Smith; 7—H. W. Kurtz; 8—J. H. Earle; 9—H. P. Cooper; 10—N. H. Wagner; 11—R. L. Combs; 12—C. M. Hill; 13—R. J. Kehl; 14—J. B. Dunlap; 15—E. J. Smith; 16—G. O. Carter; 17—C. J. Nyquist; 18—P. F. Killian; 19—D. C. Duncan; 20—A. C. Johnson; 21—R. A. Sossong; 22—O. C. Hibarger; 23—G. E. Richter; 24—E. L. Mills; 25—J. Clendennin; 26—H. Swartley; 27—Joseph Halla; 28—G. B. Luckett; 29—David Ahldin; 30—H. G. Offut; 31—W. H. Wadsworth.

32—John Kruesi; 33—Jno. A. Johnson; 34—Geo. B. Walker; 35—S. M. Wiley; 36—A. Cressey Morrison; 37—Joseph Scales; 38—L. B. Mackenzie; 39—H. S. Smith; 40—J. I. Banash; 41—G. D. Purdon; 42—F. B. O'Connor; 43—W. S. Noyes; 44—R. E. Bruckner; 45—H. S. Card; 46—L. F. Franz; 47—F. M. Moorehead; 48—R. L. Miles; 49—W. A. Slack; 50—W. M. Beard; 51—J. O. Miller; 52—W. P. Roberts; 53—P. J. Burns; 54—M. M. Weist; 55—A. S. Kinsey; 56—H. Helper; 57—L. F. Zimmer; 58—Frank Burton; 59—R. C. Longhead; 60—W. H. Hale; 61—J. C. McCabe; 62—Eugene Arms; 63—R. McCabe; 64—W. O. Williston; 65—A. R. Small; 66—H. C. McClelland; 67— J. B. Finnegan; 68—J. Herron; 69—P. G. Peik; 70—H. W. Cook; 71—Harry Adams.

The Welding Engineer

Reg. U. S. Pat. Office.

Published on the 17th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,

608 S. Dearborn St., Chicago, Ill.

Telephone Wabash 7134.

L. B. Mackenzie.....President and Editor
H. S. Card.....Associate Editor
R. L. Miles.....Associate Editor

Subscription payable in advance and postage free.
United States and possessions and Canada.....$3 a year
Foreign Countries ..... 4.00 a year
Single copy, domestic .....25 cents
Single copy, foreign .....30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 15th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

The Welding Engineer in Great Britain.
Capt. D. Richardson, Northampton Polytechnic Institute, Clerkewell, London, E C. 1, England, is our accredited representative in Great Britain for obtaining new subscriptions to The Welding Engineer and The Welding Encyclopedia.

The Welding Engineer in Australia and New Zealand.
Mr. R. Hill, Matlock House, Devonport, Auckland, New Zealand, is our accredited representative in Australia and New Zealand for obtaining new subscriptions.

VOLUME 7 NOVEMBER, 1922 NUMBER 11

Contents for November

Special Uses for Preheater.....19
Liquid Oxygen as an Explosive.....20
Salvaging Real Sstate with a Cutting Torch.....20
The Welding Arc and Eyesight.....22
Repairing Cylinder Blocks.....23
Recollections of a Salesman.....24
Camp Built of Carbide Cans.....25
International Acetylene Association Convention.....28
Editorial 29
How Thermit Welding Helped Build a Bridge.....32
Getting Results from the Welder.....34
Cutting with Oxygen.....36
Tests of Welded Plates.....41
Current Welding Literature.....48

The First Qualification

ONE old timer has defined a good welding supervisor as a man capable of estimating the quality of a weld by looking at it over the operator's shoulder. Undoubtedly this is the most important qualification of a supervisor or foreman. This kind of supervision results in uniformly good welds, and good welds mean the most economical production. As a general rule good welding also means faster production. For example, in one group of ten welders, working on a pressure pipe job, the three best workmen are averaging fifty per cent more welds per day than the average of the other seven, with practically no failures. Welders have to be selected according to their demonstrated ability, rather than on their own estimate, if a good welding crew is desired, and it takes an expert to pick them out.

How Long Shall a Welder Be Trained?

IT appears to be difficult to convince apprentice welders that welding is not to be learned in a short course of lessons. A well known manufacturer of pressure containers puts the time at two or three years from the time the operator first attempts to weld until he is considered competent to handle responsible work. This makes sufficient allowance for the difference in the intelligence of the beginners. This may suggest to some users of the process who are not satisfied with results, that they have been too lenient in their requirements as far as training is concerned.

The Service Man

ONCE in a while the welder meets a service man who tells him how to do that difficult job, and neglects to tell him that he is using the wrong equipment or the wrong filler rod, or the wrong gas. This service chap even makes necessary repairs or adjustments to competing apparatus. He is a mighty popular man in his territory, and he isn't hurting his employer's cause in the least.

A Record for Good Welding

WHEN the International Acetylene Association invited Mr N. H. Wagner, superintendent of the Prairie Pipe Line Co., to describe his welding operations at their convention, they were prepared for a good paper, but they were not prepared for a report of such surprising results on a large scale. This company completed 140 miles of welding on an 8 in. pipe line, which under test developed no failures, and showed only a few porous spots which were easily stopped up. One of the mathematicians in the audience estimated that the welders working for this company had averaged only one pin hole to two miles of actual welding. This is, undoubtedly, the record for successful work. This is also a record which every firm interested in oxy-acetylene welding should note very carefully, and use for evidence whenever the possibilities of welding are in dispute. The fact that these pipe lines are subject to a pressure of from 600 to 800 pounds when in service puts the welding in a class with the very highest grade of work.

Welding Critics

ONE of the biggest difficulties in the way of a really constructive discussion of welding subjects at the meetings of engineering socleties is the attitude taken by those who would like to discuss welding, but who are not in a position to do it intelligently. The men who are really in close touch with the needs of the industry, and who have the good of the industry at heart, do not express any doubt as to the

ROCHESTER GAS AND ELECTRIC CORPORATION
ROCHESTER, N.Y.

September 20, 192[illegible].

W. F. Reich, Jr. Dist. Sales Mgr.
The Prest-O-Lite Co.,
1007 White Bldg.
Buffalo, N. Y.

Dear Mr. Reich:-

Sometime ago an unforeseen shortage of Prest-O-Lite necessitated our communicating with your office via. long distance telephone about 5:00 P.M. one evening with the result that delivery was made to our yard the next morning.

Recently this emergency was repeated and we again telephoned your office. Although this call was made late in the afternoon your prompt action in getting a shipment of Prest-O-Lite started to Rochester the same evening prevented a possible delay in our yard operations.

Service of this character is worthy of commendation and we assure you it is appreciated.

Yours very truly,
ROCHESTER GAS & ELECTRIC CORPORATION
E. R. Crofts
Purchasing Agent.

E. R. Crofts/L

Shadows of Coming Events

The cutting and welding torch is regularly called away from its routine tasks to bridge over an emergency breakdown.

Years of experience have taught Prest-O-Lite that satisfactory service must anticipate unexpected gas needs on such occasions. Hence Prest-O-Lite service, built to satisfy the user's needs, rarely fails to have foreseen the emergency.

Each Prest-O-Lite user looks to his nearest District Sales Office, not merely for arrangements to adequately cover acetylene needs, but for helpful co-operation and advice on any matter involved in the use of acetylene.

Prest-O-Lite
DISSOLVED ACETYLENE

DISTRICT SALES OFFICES

Atlanta	Buffalo	Dallas	Milwaukee	Pittsburgh
Baltimore	Chicago	Detroit	New York	St. Louis
Boston	Cleveland	Kansas City	Philadelphia	San Francisco

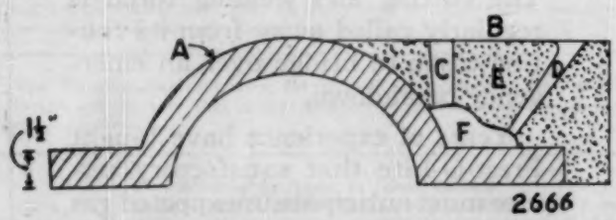
THE PREST-O-LITE COMPANY, INC.

General Offices: Carbide and Carbon Building, 30 East 42nd Street, New York
Balfour Building, San Francisco; In Canada: Prest-O-Lite Company of Canada, Limited, Toronto

possibilities of making a good weld. Most of the criticism of the welding processes seems to come from those who are not thoroughly familiar with the processes, and who would not be able to tell by watching an operator work whether or not he was doing a first class job. It is from this quarter that the complaints of the uncertainty of the processes are unduly exaggerated. The welders themselves, and the men who are developing the welding processes, are fully aware that a careful training of operators is always necessary. There have been a number of meetings held in different sections of the country in the past six months, at which the subject of welding was under discussion, and in many cases stories have been told of welding failures. Unfortunately, these stories were not presented by men who had secured enough of the facts so that the blame for the failures could be laid to the proper parties, or who knew enough about welding procedure to suggest the proper remedies.

HOW THERMIT WELDING HELPED TO BUILD A BRIDGE

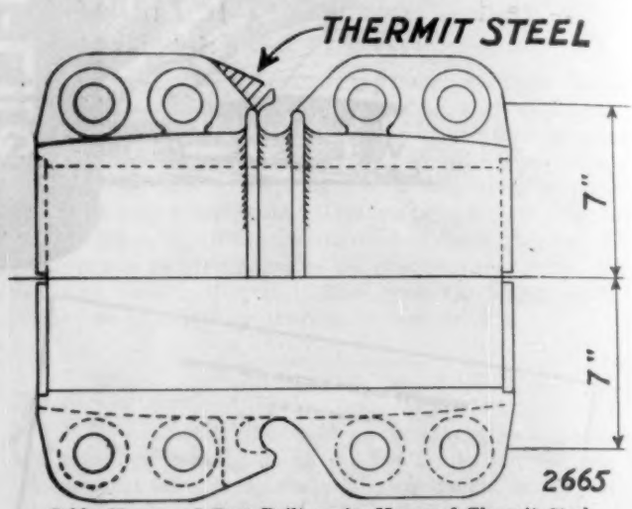
When the new 1,145-ft. long Rondout Creek suspension bridge, which was recently constructed and placed in operation near Kingston, N. Y., was being built, it was found that the cast steel cable clamps by means of which the vertical cables were suspended from the suspension cables provided for only one flange to hold the vertical cable from side-slipping off the clamp shoulder and that an additional flange was needed on the opposite side of the shoulder. As the builders were in a rush, it was decided instead of waiting for new clamps to be cast to weld this additional lug to each of the 114 clamps at a local foundry by means of thermit welding.



Method of Constructing Mold for Building up Eng. on Cable Clamp. A—Cable Clamp Casting. B—Mold. C—Riser. D—Pouring Gate. E—Molding Material. F—Thermit Steel.

In preparing for the welding operations, a wooden pattern was first made of the half clamp to be welded. A wooden lug pattern for the thermit steel flange was doweled to the pattern by means of two holes drilled into the pattern. A three sided wooden box, hinged at one corner, was then placed with its open side against the pattern, clamped to the pattern and rammed with molding material. The usual wooden riser and pouring gate patterns were inserted against the lug pattern. No preheating gate pattern was inserted as the preheating was executed in a different manner, from usual, as explained later. When the ramming was completed and the molding material rammed up flush with the top of the mold box, the riser and pouring gate patterns were removed, a plate placed over the mold; the mold, casting pattern and plate inverted and the mold box and pattern removed from the mold, which now rested on the plate.

The mold was next baked in an oven. In the meanwhile, the part of the casting to be welded was preheated over a blacksmith forge to a temperature suitable for welding. When both the opertions of baking the mold and preheating the casting were completed, the baked mold was applied to the casting in the position shown in Fig. 1 and the thermit steel poured into the mold in the usual manner, using 10 lbs. of thermit for each weld.



Cable Clamp and Port Built up by Means of Thermit Steel.

Much time was saved by preparing the molds for baking in close succession by applying the same mold box to the same pattern just as soon as the former was removed from one unbaked mold; also by preheating the castings successively while the baking of the molds was taking place. In this manner an average of about twenty-five welds per day were made.

Fig. 3 shows the complete bridge with the welded clamps installed on the cables.

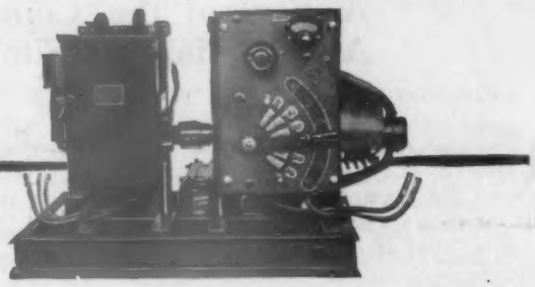
General View of Rondont Creek Bridge. The Flanges on the Cable Connecting Plants Were Welded on by Means of Thermit Welding.

Achievement

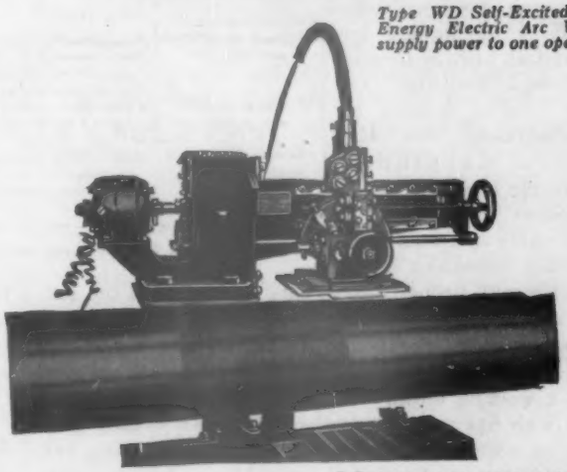
Achievement—in terms of service to you—is here represented by types of G-E Arc Welding Equipment.

From the first sets for hand welding operations to the new type of Portable Semi-Automatic Arc Welder—the General Electric Company has been a pioneer in the design and manufacture of equipment which gives to Industry the broadest uses of arc welding.

G-E Arc Welding Specialists are at your service to select the right equipment for production, repair, or salvage in your plant.

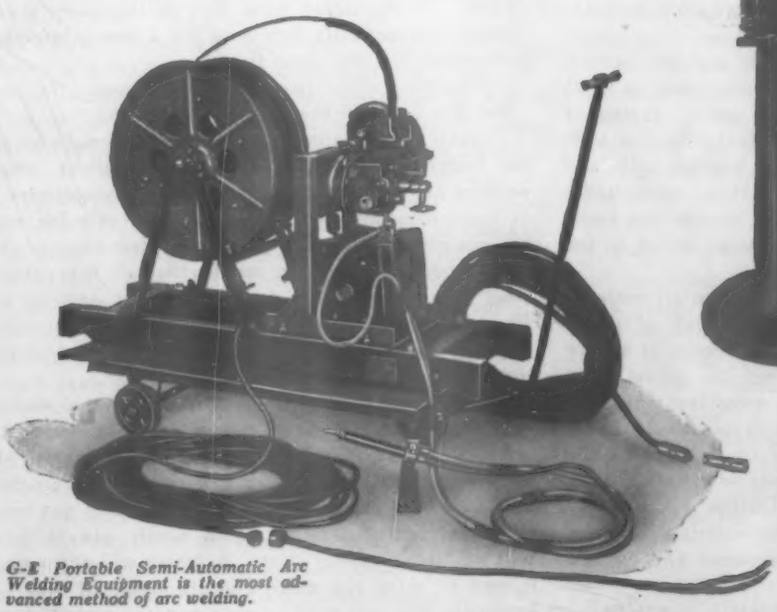


Type WD Self-Excited Constant Energy Electric Arc Welder to supply power to one operator.



G-E Automatic Arc Welder builds up worn or under-cut surfaces of shafts, axles, etc., and is also used for welding seams of pipes, tanks, etc.

G-E Semi-Automatic Arc Welding Lead is a device to be attached to the G-E Automatic Arc Welder which obtains the continuous welding features of the automatic welder, and permits the operator to direct the arc as required by the conditions of the work.



G-E Portable Semi-Automatic Arc Welding Equipment is the most advanced method of arc welding.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

43B-651

BETTER RESULTS FROM THE WELDER

A Few of the Common Difficulties Experienced in Arc Welding and Simple Methods of Overcoming Them

By R. H. Davis

IT is well understood that the majority of arc welding operatives, and even foremen and sub-foremen, are not skilled electricians. But it often happens that they are far too conscious of this fact and occasionally delay themselves by waiting for expert electrical help in getting out of a simple difficulty. Of course the general welfare of welding equipment, like any other electrical machinery, should be in the hands of someone who knows what he is doing. Some cases of trouble are due to obscure difficulties and a real electrician with proper instruments should be on the job. However, one would hardly call a stomach specialist for a simple case of green-apple colic. And, likewise, it is not always necessary to call an electrician to fix up the simpler troubles in a welding outfit.

TROUBLES OF ARC-WELDING OUTFITS

SYMPTOM	PROBABLE TROUBLE	TEST
Current varies	Broken lead Poor ground connection Heavy intermittent load	Examine lead Examine ground Watch lights
Current seems too hot but penetration is poor	Reversed polarity	Use graphite electrode Use dish of salt water Use volt meter Use polarity indicator
Current dies down 1. Speed of M-G set falls off	Supply line too small Poor contact in motor circuit Fuse blown (3-phase motor) Motor commutator dirty	Examine Feel for hot spots Motor growls Examine
2. Speed of M-G set holds up	Generator commutator dirty Loose field connection	Examine Examine
Arc hard to start and hard to hold	Separately excited field not working Field adjustment out of balance	Open circuit voltage low Inspect setting of rheostats

Chart Shows How to Keep the Arc Welder in Condition.

A parent who has raised several children can usually give some hints on remedies for "tummy-ache" and one who has spent several years as electrician, arc welder and supervising welder may be able to offer some useful suggestions on the ailments of arc welding equipments.

The welding systems in common use may be grouped, for our purposes, into two general classes; the multiple-operator system, wherein several operators are supplied from one generator, and the single-operator style, where each operator is supplied from a separate motor-generator set.

In the first class, the generator which supplies several welders may be either a special machine operating at 65-75 volts or it may be part of a regular D. C. supply system at any voltage up to 550 (street railway current). Such a multiple-operator generator is usually large, heavily built and well installed in a permanent location. It is often under the care of a skilled attendant and cases of trouble can rarely be traced to the generator but will usually be found in the welder's own lead or regulating rheostat.

The one-man set, on the other hand, is given all sorts of treatment. It is frequently dragged around out of doors in all sorts of weather and made to run for weeks at a time with practically no attention. When things go wrong on a one-man set the whole outfit is under suspicion until the difficulty is located. However, unless you positively know what the trouble is, it is a safe rule not to tinker with the set. Look the lead and ground connections over first.

Troubles Common To All Outfits

Certain difficulties common to both the multiple and the single-operator systems are indicated, diagnosed and treated as follows:

Symptom:—"My juice is no good. First it is too hot and then too cold and then too hot again."

Look for a poor connection in the welding circuit. The first place to look is about six inches from the electrode holder where the flexible lead will very often be found broken and twisted nearly off. The variation in current at the arc comes about as this broken place is twisted about and a better or poorer contact is made. The next place to look is where the return or ground is attached to the work. Welders sometimes fail to realize that all the current that goes through the arc must somehow get back to the generator. "Any old thing," for a conductor and loose, poor and dirty contacts on ground connection are the general rule. Sometimes a ground will be so made that first a good contact and then a poor one will be caused by the wind swinging a wire, the operation of nearby machinery, or even people moving about. From an electrical viewpoint an all-metallic and preferably an all-copper return or ground connection is much to be preferred. For ordinary work (up to 150 amperes), a copper lug with one square inch of contact surface, firmly clamped to a place on the work that has been scraped clean of dirt and paint, will seldom give trouble, and then only if carelessly put on or allowed to work loose.

If both the lead and the ground connection are O. K. and of sufficient size to carry the current the trouble may be due to an attempt to carry too large a load over too small a supply line. Other welders or other machinery, such as a heavy elevator, may be on the same line and the combined load cause an excessive voltage drop. Although the remedy for this condition is usually out of the welder's hands he should be able to tell what the trouble is due to. It is possible to make sure by watching lights connected to the same circuit. If the lights burn dim at the same time that the welder's current fails then look for a heavy intermittent load somewhere on the same line.

Symptom:—"My juice is acting funny. It seems way too hot but still there is no penetration."

Trouble is sometimes due to the welding wire used or to the material worked on. In a large plant where several welders are employed welding wire will sometimes get mixed or even sometimes wire entirely unsuitable for welding will be sent out from a supply room or department. This possibility should be kept in mind although the particular difficulty is almost always due to reversed polarity at the arc. Experienced welders can usually tell by the action of the metallic arc if the polarity has been reversed, particularly if overhead work is attempted.

A quick, easy, positive test is to have a small piece of graphite electrode handy, slip it in the holder and strike an arc. When $\frac{1}{16}$" wire is being used the $\frac{1}{4}$" or $\frac{3}{8}$" size graphite about right for testing polarity. The graphite should have a fairly good point. If the work is positive and the elcetrode negative (as it should nearly always be), the arc will be fairly easy to start. A crater will form on the work in two or three seconds. The graphite will heat slowly and gradually and will tend to maintain its pointed shape. However, if the polarity has been reversed so that the work is negative the arc will be harder to start and when established it will not be smooth and quiet but will spit, flare and jump around. No crater will be formed on the work. The graphite electrode will heat up very rapidly and the pointed end will vanish as though knocked off by a hammer. If this test is tried a few times on a circuit where the polarity may be reversed purposely no mistake need ever be made.

Another test is to dip one end of a wire connected to the

work and an end of a similar wire connected to the electrode holder into a dish containing salt water. Hold the ends of the wires a couple of inches apart. Bubbles will rise in much greater volume from the negative wire. This test is not so handy nor so reliable as the first one. Most d. c. voltmeters have their terminals marked + and —, but if it is not desired to test polarity in this manner, a small, compact and cheap polarity indicator can be secured.

Troubles on One-Man Sets

While the troubles just mentioned are the more common of those which affect both the multiple and the single-operator system there are certain ailments which usually appear in the single-operator systems.

Symptom:—"My juice starts in all right but after I have burned an inch or so of wire, it is too weak."

It should be first ascertained if this condition holds *every time* the arc is started. If not, this is quite probably a variation of one of the first two mentioned troubles and due to a poor connection somewhere or a heavy intermittent load on the same supply line.

If the condition holds every time the arc is struck then the place to look is around the motor generator set. First see if the supply line from the main feeder to the motor is heavy enough. Some electricians have a habit, on temporary hook-ups especially, of putting in a No. 14 wire to carry 35 amperes. If something like this has been done the set will run up to speed when running light but when the arc is started the speed will at once begin to fall off. As soon as the arc is stopped the speed will pick up again, and then the same thing right over. This happens because the voltage drop is so great over the small wire that not enough power is supplied to keep the set up to speed. A poor contact on the motor supply line will some times have the same effect. If the motor is three phase a. c. and acts as above at the same time making a peculiar and unusual growling or howling noise it is almost certain that one fuse is blown, allowing the motor to run single phase. As before, the motor comes up to normal speed when light but falls off when load is applied.

A direct current motor will sometimes be neglected until the brushes are sparkling and the commutator is black. Almost anyone can sand a set of brushes and clean up a commutator but no one should attempt it without first learning how from a competent electrician or from a good electrical book.

When the arc fails as above but the set holds nearly up to no-load speed the trouble is more likely to lie in the generator. A dirty commutator and a sparkling set of brushes will often be found to blame. The field system of a welding generator is unusually complicated and a loose contact in a field circuit can cause some mystifying actions.

Symptom:—"My polarity is right and there seems to be enough juice but the arc is hard to start and hard to hold."

The source of this trouble often lies in the separately excited field of the generator. The little exciters furnished with some a. c.-d. c. sets sometimes develop poor contacts, sparking brushes and dirty commutators. Again, and very often, the properly balanced action of the fields has been upset by unskillful adjustment. The welder who sets his "amps." rheostat wide open and then attempts to secure all necessary adjustment with the "volts" control, or vice-versa, is courting trouble of just the sort under discussion.

In general it might be called to the attention of welders who are without previous electrical experience that about ninety per cent of the troubles in a welding circuit are due to very simple causes. No extended knowledge or experience is needed to find and correct them. The proper operation of a motor-generator set requires only a little specialized knowledge and some common sense. It will not hurt any welder to be familiar with a few of the rules governing the behavior of a circuit and the operation of electrical machinery.* In nine cases out of ten, or oftener, the welder can clear up his own troubles and restore his outfit to service without outside help.

THE LAFFITTE PROCESS OF WELDING

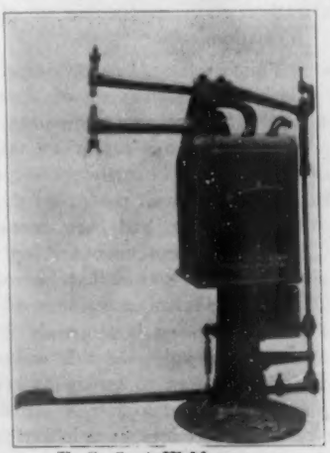
The Laffitte process was invented in 1879 by a Frenchman and formerly found its largest market in France and Germany. It is now used in engineering workshops all over the world. It may be described as the handy application of a patent fluxing sheet—known as a Laffite plate—between parts to be welded. The plates which are about 1/16 inch thick consist of a special preparation molded over a sheet of wire gauze. The preparation which acts as a fluxing medium also contains chemicals which make welding possible at a lower heat than forge welding.

The pieces to be welded are brought to a cherry red and forced together with a Laffitte plate between the surfaces to be joined. As the two surfaces are forced together, the flux melts and fluxes both surfaces as it flows. The gauze is partly melted and welds itself in place on both surfaces. It is not necessary to use more of the plate than will cover both surfaces and the plate can be cut with ordinary shears. Test results have been published showing that the strength of a Laffitte joint on medium steel is approximately 90 per cent the strength of the original metal. Tests made by the writer on a series of joints made by this process gave a wide variation in the results, thus indicating that considerable practice and skill is required to obtain uniform results.—

By D. Richardson in the Acetylene and Welding Journal.

NEW SPOT WELDER

The U. S. Electric Welder Company, 327 Permanent Building, Cleveland, Ohio, has placed on the market a new type of welder, S A F, for light and medium stock. Equipped with U. S. welding transformer. The internal automatic reactence prevents breakdown at overload and enables the welder to handle heavy stock without overheating. The automatic switch is equipped with magnetic blowout, removable contacts and is enclosed. A 5-point pivot switch provides different voltages at the welding point, which are water-cooled by means of a new system. All mechanical movable parts are of a special alloy or cast steel, therefore, light. Extra heavy pressure on the points can be obtained if desired.



U. S. Spot Welder.

It is claimed that this welder will weld rough oxidized as well as smooth stock. About four seconds per weld is required for $\frac{3}{8}$ inch. The production of two $\frac{1}{8}$ inch bright sheet is estimated at 4,000 welds per hour. All conductors carrying line voltage are enclosed and the welder is also equipped with Getz oilers.

The former owners of the Electra Welding Company, Bartlesville, Okla., have sold their shops and reorganized as the Welding Engineer Company, which will do contract work only, specializing on the electric welding of large storage tanks.

The St. Petersburg Welding and Machine Co., recently organized by T. D. Orr and A. M. Galaber, is planning to install a machine shop.

**See "Welding Encyclopedia, Second Edition, pages 150 to 153.*

CUTTING WITH OXYGEN

Some Notes on the History of the Oxygen Cutting Process and a Few Useful Hints to the Man Who Handles the Cutting Torch

New Orleans, La.

Dear Ed:—

I've got some real news for you in this letter, and some mighty good information, but before going on, I want to warn you that if anyone ever tries to tell you that it don't get hot down in New Orleans, you just ask them to jump in the lake. I've lived through some mighty warm weather in my day but yesterday and today surpasses everything. At that though, there's something about the town that rather appeals to me and while I'd never care to make my home here, yet it's a fine stopping place.

Well, Ed, this letter is going to do with cutting and cutting only. I know that you have taken a lot of things for granted in cutting and, while you have done a little cutting off and on, that you never made a study of it like you did welding. Frankly, I'll confess that I've never paid much attention to it except that time out on the Pacific Coast where I found them cutting under water at the Bremerton Navy Yard. Well sir, I've learned more about cutting in the last three hours than I ever hope to learn again. And now, that it is fresh in mind, I'm going to pass it on to you. But before giving you the story, I'll let you have a little jolt. Many is the time that I've heard you tell that the oxy-acetylene process of welding is a very recent thing. If I remember correctly, you indicated that as applied commercially, about 1905 would be a good guess. Naturally it was experimented with for several years previous to this time but in 1905 it really started to take hold. Now I don't know whether you had the same idea as I did but I always figured that cutting with oxygen had about the same dating. Imagine my surprise, if you can, when I found out tonight that oxygen cutting is recorded as far back as 1881 and has been used ever since. Great Stuff! But here is the proof—no, methinks I'll give you the whole happening. You'll probably enjoy hearing about the rather queer manner in which I happened to pick up this information.

This evening I was sitting down in the lobby taking considerable pleasure out of a fat cigar, and looking over a new catalog on welding equipment. I was conscious of the man on my right taking rather an undue interest in my catalog but I said nothing. Finally, however, he spoke up. It appeared that he was very well posted on the Oxy-acetylene game and up until a recent date, had been connected with one of the big manufacturers of equipment. After we had talked for a few minutes, it was plain to see that he really was very well versed in this subject and had a volume of information right at his fingers' ends. Knowing how greedy I am for all the news in this line, you can imagine how I welcomed, and promptly accepted, his kind invitation to go up to his room, where we could talk uninterrupted and look over some specimens that he had in his bag.

Well sir, I may have looked incredulous at some of his remarks and you probably would too, were you present. At any rate, he dug down in his bag and produced a roll of papers and proceeded to convince me that oxygen cutting really was used as far back as he contended. First he showed me a signed statement by J. W. Fletcher, the managing director of the Fletcher, Russel Co., Ltd., of Warrington, England, which was dated and read as follows:—

Warrington, May 10, 1901.

We have pleasure in certifying that the process of cutting metal plates by means of a blowpipe working with compressed oxygen and coal gas has been used for over 20 years at these works.

Fletcher, Russel Co., Ltd.,
Signed by, J. W. Fletcher,
(Managing Director)

There is no denying a certified statement of this kind and if the process had been used for over twenty years in that shop, and it was dated 1901, naturally that would carry back to 1881. As if to vertify this: I was next handed a copy of paper called the "Engineer" printed in London, and dated March 23, 1881. On page 235 appeared an article on oxygen cutting. After that, I glanced over some fifteen or twenty more papers and magazines that he had, all of which were published between 1881 and 1890, containing descriptions of oxygen cutting processes. Some of these didn't prove anything to me, for outside of being able to read such names as Berlin and Vienna, I couldn't make head or tail of them. There was one article from an English paper that rather amused me. It was in the "Financial News" of March 13, 1888. On page 3, col. 6, there was an article called "Is a Safe Still a Safe?" It was written in rather a jocular vein and went on to say that safes were no longer to be trusted now that this most wonderful metal cutting blowpipe had been discovered. I wonder if some of our newspaper publishers, who believe they have a great coup when they learn of a safe being broken into with a cutting torch, would think twice if they know that back in 1888 the newspapers had beat them to it?

Having been convinced about the age of the process I was mighty glad to have him go on and give a few more side lights. He certainly was an interesting fellow. Being very observant and having toured Europe and studied the applications there, you can imagine that he had much to tell. For example, the manner in which oxygen cutting was first discovered, I had never heard before. It seems that a man who was experimenting in his laboratory one day performed that old stunt that our physics teacher in school had us all do; namely, take a light spring, get it red hot, and drop it into a bottle filled with pure oxygen. As you well remember, the heated spring instantly burnt up. Watching this experiment, this man reasoned that if any steel part were to be brought to a red heat and in place of putting it in an oxygen container, to bring the oxygen to it, that a reaction would take place. Not having acetylene gas to work with in those days, he used hydrogen and coal gas to heat with and found that he could not only burn the metal but could make a fairly smooth and narrow cut. It naturally didn't compare with the cuts of today but it was surprisingly good, considering the handicaps. After improving his equipment step by step and compressing the oxygen after it was generated, the first public demonstration was given. Certain manufacturers were quick to grasp the true worth but it did not become very popular on account of the lack of oxygen supply. In order to obtain oxygen it was necessary to put in chemical generators and then use compressors. However, as the demand for oxygen increased, plants were erected and the demand satisfied.

Thinking to get a comparison between cutting with acetylene, hydrogen, and city gas, I asked him about it.

"My dear fellow" (that was his pet phrase), "I've been asked that question dozen of times and the only fair answer I can give you is this:—considering all conditions such as clean boiler plates; dirty plate with much scale; shafts, etc., acetylene will prove the more efficient but on certain places where it is all clean plate to cut, then hydrogen or city gas will save money. Not perhaps as much as some users may suppose, for the simple reason that while their fuel gas may not cost them as much, yet a greater amount of oxygen is required then when acetylene is employed. The reason for this is on account of larger preheating flames being necessary and naturally it follows that there will be a greater consumption of oxygen. There are other ad-

vantages to be considered in using hydrogen and city gas. Both these gases produce much smoother cuts than acetylene and are less susceptible to "back fires."

"Which would you prefer, city gas or hydrogen, if it came to a choice?" I asked him.

"Well, it would largely depend upon circumstances," he answered. "There are so many different conditions to consider in the work itself and then of course there is city gas and city gas. It all varies but I have an analysis here of the gas used in one of the larger cities, which reads like this:— (Here he produced a chart which showed these figures.)

Acetylene	22%
Hydrogen	35%
Carbon Monoxide	25%
Illuminates	10%
Other miscellaneous gases	8%

"So you see that a mixture of acetylene and hydrogen form a good share of this particular city gas. Now if the work to be cut were not over two or three inches thick I'd recommend city gas providing I could get the proper blowpipe, but for heavier cutting I would prefer hydrogen."

My next question was whether there were any outstanding differences that the acetylene user would notice in starting to use hydrogen or city gas.

"My dear fellow! Certainly there are. Two of them will be noticed immediately. It requires a much longer time to start a cut with hydrogen and city gas than with acetylene and another thing will be the ease with which a heat can be lost. With acetylene the metal is heated almost instantly because of the intense flame, whereas, with the other gases, it requires perhaps twice as long to get the same heat. And as you might suppose, when sand pockets or laminations are encountered, acetylene has the advantage on account of being the hottest flame and the heat is not lost as quickly."

"From that, I take it that you consider acetylene the better fuel gas to use," I suggested.

"For all around cutting, yes," he said "but hydrogen and city gas both have their field. For heavy cutting, say six inches up to twenty-four, hydrogen has the honors. For the clean plate below six inches, city gas would probably work out best if the cuts were long but for the general run of cutting as encountered in the average scrap yard, acetylene is really the gas to use."

After we had talked on awhile, the subject of apparatus was touched upon. "Yes Sir!" he went on, "it's interesting to follow the evolution of certain equipment parts. Take back in the early days with the cutting torch for an example. They were all made to use three hoses in place of two. Using three lines, it was necessary to use three tanks and three reducing valves. One day somebody conceived the brilliant idea of carrying all the oxygen gas in one hose as far as the torch and there divide it into two pressures, one for the preheating flame and the other for the cutting jet. This idea met with the immediate approval of all cutters for it meant only two cylinders in place of three and one less regulator and hose to take care of."

"The two hose cutting torch will satisfy the average run of cutters," he continued, "but in many of the larger industries where extra heavy cutting has to be done and trouble has been experienced with 'flash-backs,' they are going back to the three hose cutting torch. Their reason for so doing is simply this:—with the cause of 'flash-backs' completely solved, it is possible by the use of two regulators to control the line pressures of oxygen and have it so proportioned that a 'flash-back' will be impossible. So you see, first the pendulum swings one way and then it swings back."

When asked to criticise the average cutter he had a good "come-back" and it would do a world of good if every operator doing cutting could get his idea.

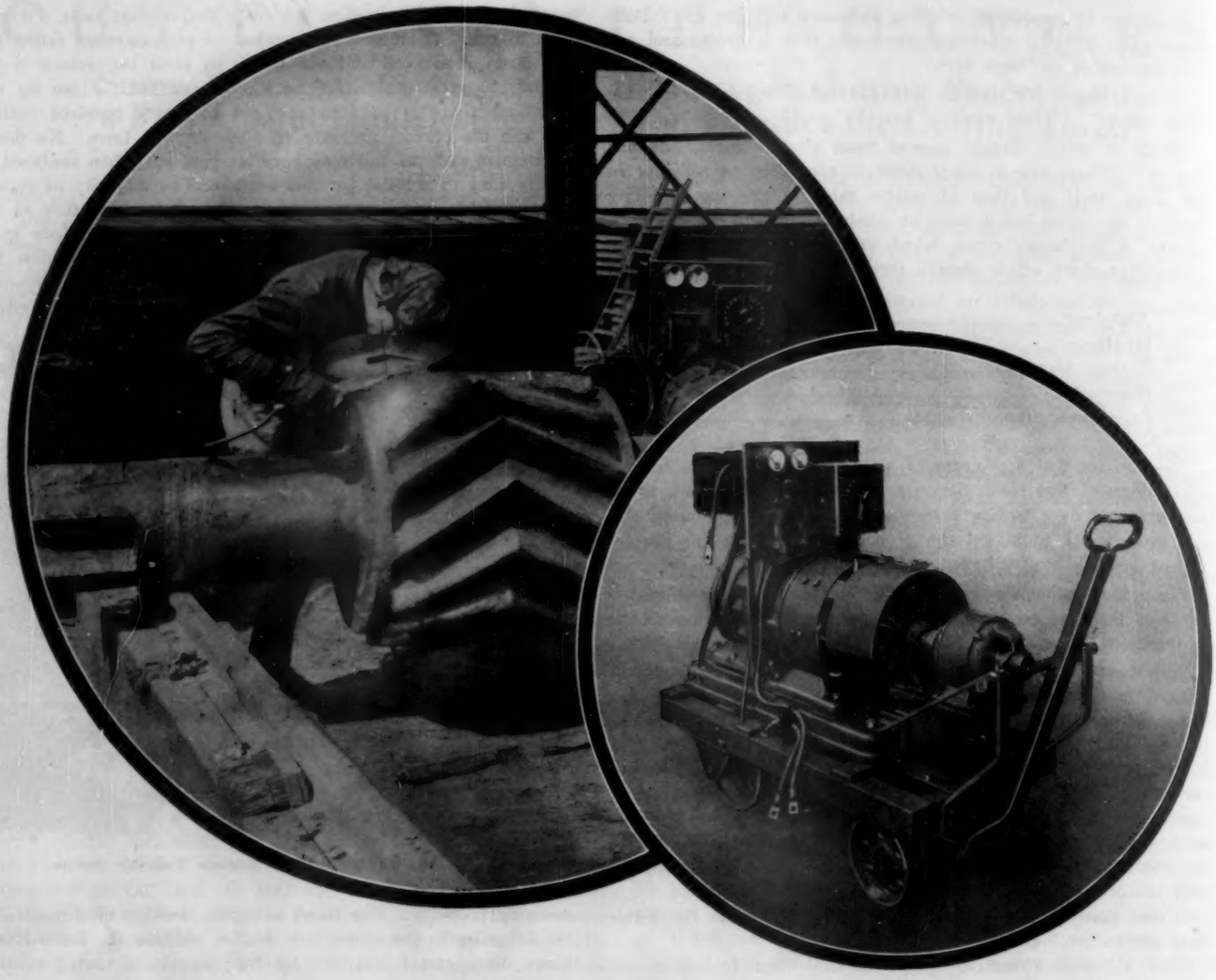
"My dear fellow," he answered, "you are pining me right down to earth, that's plain to see, but since you request facts, I'll give them to you. There are any number of very common faults but the most pronounced and one which of most importance is the use of too great a pressure on the oxygen line. From my observations there is not but one out of every hundred cutters who use the correct pressure on their oxygen lines. No doubt a statement such as this may surprise you, but when analyzed, it is very easy to account for this mistake. The majority of cutters know that it's necessary to increase the oxygen pressure as the metal to be cut increases in thickness. It is therefore quite natural that, in order to speed up their cut and to blow the slag clear of the metal, they should increase the oxygen pressure. With most cutting blowpipes, this has just the opposite effect. The oxygen, issuing as it does at a much greater velocity from the tip, seems to have a cooling action and looses much of its

How a Cutting Torch Can Salvage Valuable Scrap.

oxidizing property. The result is a poor looking cut; much slag left adhering to the under side and in addition the loss of both things the operator was striving for; namely, a saving of time and gas."

"To operate most efficiently," he continued, "a great deal of attention should be given the adjustment of the flame and the pressure of the oxygen which is to do the cutting, until the operator has satisfied himself that the right pressures have been found. It is to be supposed that apparatus of different makes will function differently but invariably, they will perform much better by using as low a pressure as possible. In adjusting the per-heating flames they should be kept short, unless the work is dirty and rusty, and should be as soft as possible. The ideal condition would be to have the flames burning so softly that if the tip were to be held up near the ear that the flame couldn't be heard. This, of course, is ideal but not expected in actual service but it brings out the right idea. It's not the blowy, hissing flame but the hot gentle flame that's so desirable. With the pre-heating flame once set, the oxygen in the cutting jet must be considered. This regulation is very simple. Commence with as low a pressure as possible and increase slowly until the pressure is sufficient to easily penetrate the thickness of the metal. With the reducing valves set thusly, the average operator will be greatly surprised at the difference in his cuts and will hardly believe his eyes when he reads the pressures on his gauges."

"You asked for a general criticism I suppose," he went on, "so I'll cite another very common fault with cutters. The angle at which the blowpipe is held and the distance of the tip from the work are other points given too little consideration. In nearly every instance it is desirable to hold the tip at a slight angle and inclined so that the flames are a little in advance. Greater speed can be obtained by holding the torch at this angle and, with the end of the pre-heating flames just licking the surface, the reaction will be as complete as possible."



Westinghouse Equipments

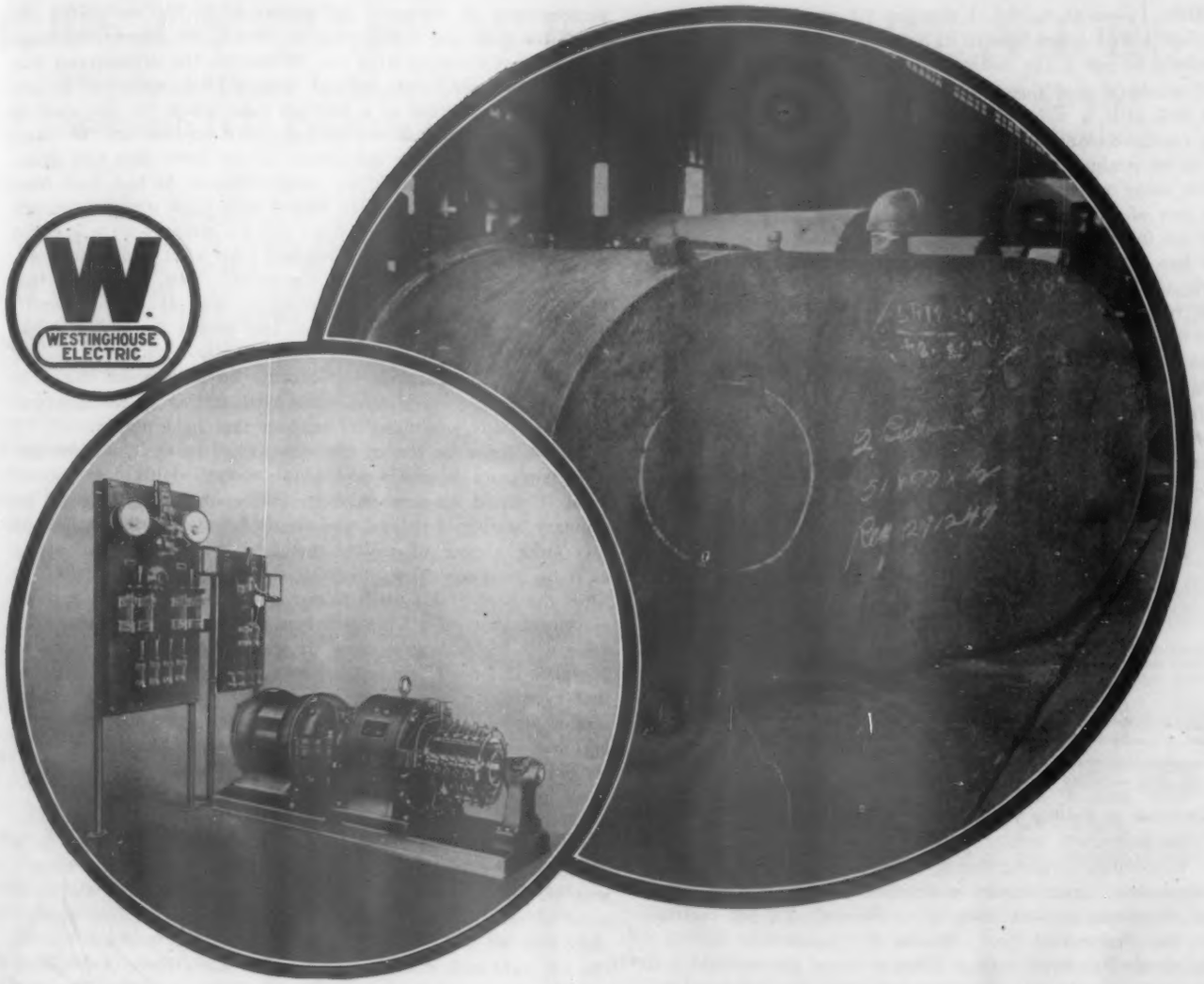
Of all the factors which enter into the making of a perfect weld, arc steadiness and arc control are of prime importance.

The idea back of the Westinghouse Equipment was to build a machine which would assist the operator in obtaining good welds consistently, and yet have a rugged simple design and construction.

The first thing done was to simplify the design as much as possible in order to secure an easy running, rugged machine to give continuous operation for steady welding work.

Second, a control system was worked out by Westinghouse Engineers, a simple, strong controller, giving the op-

Westinghouse



Assist the Operator

erator any current he may desire at the arc, or a single, steady current for a full day's work from a single rheostat. This flexibility is one of the distinct advantages of Westinghouse Welding Equipments where the Welding work is variable.

And lastly, the Westinghouse Equipments were perfected in all sizes from the popular 175 Ampere portable equipment to the heavy multiple operator equipments which have made Arc Welding such an important factor in modern production.

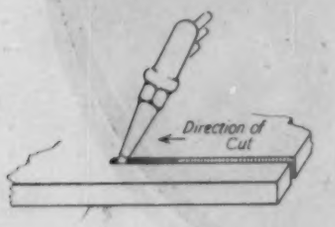
Westinghouse Electric and Manufacturing Co.
East Pittsburgh, Pa.
Sales Offices in all principal American Cities

Westinghouse

While I was at it, Ed, I thought I'd get his expression on regulators so I asked him if in his opinion it harmed a welding regulator to use it for cutting.

"I wouldn't recommend it," he replied, "for no matter how you look at it, a welding regulator is manufactured for a sensitive regulation of the gases and if used for cutting it is very apt to be strained. The sudden jolts to the diaphragm and seat, which occur when cutting certainly won't do it any good. No, I'm sort of a crank when it comes to using tools in the places they are intended, so I'll naturally insist upon a cutting regulator that has the capacity and is designed for cutting when there is work of that kind to be done. On the other hand, if any of your friends ever want to use a cutting regulator for particular welding, don't let them do it. The regulation is too coarse. If a fine adjustment is required, a cutting regulator is not the thing to use."

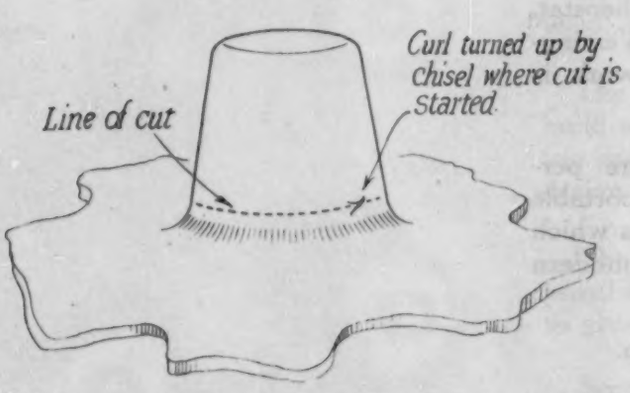
"Just a minute ago," he continued, "I was reminded of two incidents I witnessed once upon a time, that were really out of the ordinary and, while they have no connection with your last question, they may prove very valuable to you some day. Both of



Inclination of Cutting Torch.

Shooting Holes.

these happenings occurred during competitive demonstrations and illustrate how circumstances sometimes drive operators to try things they would never think of ordinarily. I'll tell you first about the 'Penetration Test'. During the recent war, the U. S. Army decided to have various manufacturers demonstrate what their torches would do. At appointed times the different demonstrators put their torches through the required tests and there was little trouble experienced until the last test was encountered. This was called the 'Penetration Test' and consisted of shooting a hole right through an eight-inch steel billet. This test proved a jinx for one demonstrator after another. In attempting to make



Starting a Cut on a Heavy Riser.

their torches go through this billet more than one tip was melted off and in fact one operator had the entire head of his torch disappear just like a flash. Still another fellow was kind enough to fill the entire room with a shower of sparks. Every on-looker in the room had his clothes filled with holes. As I say, one after another failed on this test and stated that it couldn't be done. This went on until there remained only one more man to demonstrate. It certainly did appear as if this test were too much for them and it was plain to see that the officers in charge were of that frame of mind too. When this last demontrator was making his preparations most of those present were feeling just like a crowd of fans at a baseball game when the last man up in the final inning has two strikes called on him and the bases empty. Well sir! that lad picked up his torch nice and quiet-like and before you could say Jack Robinson, he had done what the others failed to do. He shot a hole right straight through that eight-inch billet. The crowd for one moment were knocked speechless and then as they realized just what had been done, they wound up by giving one big cheer. Now, I'll wager that there wasn't one out of that whole crowd, other than myself, who knew just how this last man had turned the trick. I had watched him very closely for no particular reason that I was conscious of. Perhaps it was because he went about things so cooly. He made every move count when setting up his apparatus and there was something about him that held my interest. I could see from the size of his flame, when he lit it, that he was using an extra large tip and when he applied his flame to the billet it heated up very quickly. He was not satisfied with an ordinary heating, I noticed, and continued to pre-heat until there was quite a pool of molten metal in evidence. Then, acting as if he were accustomed to doing stunts like this all his life, he tilted the head of his torch to one side a little and with a quick movement shut off all his acetylene and at the same instant let loose with his cutting oxygen. It was all over in a jiffy and as I explained, I don't believe there was another person in that room that even today knows how it was accomplished. That demonstrator used his head! He realized that with the acetylene burning that a flash-back would occur the instant the molten metal started to fly, so all I can say is that he used wonderful headwork in closing off that valve."

"The other incident I mentioned," my friend went on, "happened in a large steel foundry. This was really amusing to a disinterested party but not to me at that time. This time I was very much interested in all that went on from the view point of sales. It was my company's apparatus against another make that we had often won over before. Our problem was to cut off eight-inch risers. I had a first class operator handling the blowpipe, so felt very confident of the outcome. You can well imagine my surprise and possibily the way I felt when I beheld our competitor cutting off two risers to our one. It simply made me sick at my stomach. I knew full well that it wasn't any superiority in the equipment but that operater had some trick up his sleeves that he wasn't letting go of, that was all there was to it. I watched him very closely, but there was no argument; with both operators starting at the same time, he would get his heat and have his cut finished while my man was getting his heat. Needless to say, the other fellow got the order. I never suspected at the time that the chisels the operators were furnished with, to clean off the moulding sand, had anything to do with the demonstration, but not being able to quite reconcile myself to the face value of the results, I returned to that foundry a couple of weeks later and cleared up the mystery. One of the foremen let the cat out of the bag and they all had a laugh on me. It seems the other operator in cleaning off a place to start, would use his chisel to turn up a little curl. Now, as you probably appreciate, it ordinarily requires quite a while to get a start on a heavy riser of this kind; after that it's easy. Well, this fellow simply played his flame on this curl; got his heat, and was off and finished, as I just told you, before my man could start. When explained, it was simple enough, but I confess I was completely lost during the demonstration. All this occurred quite a few years ago but that little trick has stood me in good stead many times since, I'll tell you that."

Other than that, Ed, there wasn't much more to tell and, inasmuch as "yours truly" has a very important engagement with friend Morpheus right now, you'll have to excuse me.

Same as ever,

Shep.

TESTS OF WELDED PLATES*

Physical Tests Which Were Used to Demonstrate How Much Strength It Is Possible to Secure Using Ordinary Welding Methods

By S. W. Miller†

IN order to determine whether the ideas which I held regarding fusion welding of unfired pressure vessels, were correct, I took up the matter with H. S. Smith, then president of the International Acetylene Association, and Prof. C. A. Adams, director of the American Bureau of Welding, and with their co-operation a number of tests were conducted.

The following program of physical tests was outlined and used in general to secure the desired determinations and observations:

Preparation. Grind top and bottom of weld as nearly flush with the rest of the piece as possible so that a fair comparison of the strength of the weld may be obtained.

Tensile. Measure ultimate strength. Yield point by drop of beam. Reduction of area by usual methods. This is not of much value if the break is in the weld, and if outside, it only shows value for original material.

Cold Bend. Clamp on side of anvil with center of weld level with top, and strike with 10-lb. sledge. Blows should be just hard enough to swing the sledge against the piece. Measure the angle to which the piece has been bent when the first crack shows, and record the number of blows. Continue till it breaks. If it bends to right angle without breaking, stand it on one end and strike the other. Examine fracture with glass and record quality of weld with regard to blowholes, laps, etc.

Hot Bend. Clamp on table or in vise with center of weld about ¾ in. away from edge, and heat weld through to a bright orange with an oxy-acetylene torch. A wide heat is not desired. Strike the projecting end with a 4-lb. sledge while at this heat. If necessary to continue, reheat to the same temperature, so that bending is done while hot.

Chemical Analysis. Both original and weld should be analyzed. In sampling the weld, care should be taken to keep away from the V about ⅛ in. to avoid the original material. The ends of the weld should be filed smooth and etched with concentrated hydrochloric acid to show the line of the "V." The top scale should be removed by picking before sampling. Use A. S. T. M. methods for analysis, and determine carbon, manganese, sulphur, phosphorus and nickel.

Microscope. The report should state: Presence or absence of FeO; general structure of weld; presence or absence of defects and their nature and relative number; microphotographs of important defects and each section at 2 or 3 diameters after etching in hot hydrochloric acid to bring out the defects. (See Bureau of Standards, Technological paper No. 156).

Details of Specific Tests

Altogether there were ten plates tested and a summarization of the general results is given in Table 1.

Specimen A was furnished through the courtesy of H. S. Smith. It was welded at the Rochester Welding Works and tested at the University of Rochester.

Specimen B, from the York Mfg. Co., was purchased with the understanding that it was same general type of material as the others but on analysis it was found to contain 0.24 per cent carbon and of about 64,000 lb. per sq. in, tensile strength. The ground test piece broke in the weld at 58,000 lb. Another cold-bend test piece of another exactly similar weld in another plate of the same material broke outside of the weld and the hot-bend test piece bent flat on itself, without cracking.

Specimen C was welded and tested by the Electro Metallurgical Co.

Table 1. Results of Tests of Welded Plates.

Specimen	Sample	Lb. Per Sq. In. Tensile Strength	Lb. Per Sq. In. Yield Point	Per Cent Elongation in 8 in.	Per Cent Reduction of Area	Weld Ground	Location of Break
A	1	50,900	32,400	25.7	.....	no	3 in. from weld
	2	50,500	31,400	27.1	.....	yes	2½ in. from weld
	4	51,000	32,000	29.0	.....	yes	3 in. from weld
B	1	58,500	43,100	4.25	.....	yes	In weld
	2	64,000	41,300	19.6	53.6	no	1½ in. from weld
	4	63,700	41,500	23.5	53.1	yes	3 in. from weld
C	1	29,750	27,300	2.3	4.2	yes	In weld
	3	31,700	27,100	3.4	4.7	yes	In weld
	5	41,100	27,100	6.6	10.6	yes	In weld
D	1	48,100	30,500	26.0	4.5	yes	2 in. from weld
	3	47,250	30,300	27.0	3.2	yes	2 in. from weld
	5	49,100	29,100	29.7	2.9	yes	2 in. from weld
E	1	51,100	32,930	31.0	59.0	no	1½ in. from weld
	2	51,680	32,700	26.6	58.4	yes	1½ in. from weld
	4	51,320	32,000	25.0	61.2	yes	Outside of weld
F	1	42,570	.....	21.9	61.15	yes	Outside of weld
	3	43,210	.....	25.9	63.4	yes	Outside of weld
	5	43,040	.....	24.0	61.5	yes	Outside of weld
G	1	50,000	31,400	.....	60.7	no	2½ in. from weld
	2	52,560	32,700	24.3	57.6	yes	2½ in. from weld
	4	52,200	31,380	24.6	53.6	yes	2½ in. from weld
H	1	39,300	.....	6.7	2.46	yes	In weld
	3	45,830	.....	21.9	67.95	yes	Outside of weld
	5	44,740	.....	11.8	3.63	yes	In weld
I	1	43,050	.....	24.4	64.35	yes	Outside of weld
	3	42,430	.....	22.9	67.6	yes	Outside of weld
	5	42,490	.....	15.1	.....	yes	In weld
J	1	40,850	.....	12.1	2.53	yes	In weld
	3	44,150	.....	22.5	73.7	yes	Outside of weld
	5	43,670	.....	22.2	70.9	yes	Outside of weld

Tensile Test. Samples Nos. 1, 3 and 5 were broken in the 100,000 pound Olsen tensile machine. The results obtained were:

Sample Number	Yield Point Lb. per Sq. In.	Ult. Ten. Strength Lb. per Sq. In.	Elongation in 2 in. Per Cent	Elongation in 8 in. Per Cent	Reduction of Area Per Cent	Remarks
1	27300	29730	4.0	2.3	4.2	Crack through ⅛ section Balance coarse crystalline
3	27100	31700	7.5	3.4	4.7	5 per cent surface cracks ⅛ silky, ⅛ crystalline
5	27100	41100	19.0	16.6	10.6	Cracks on each side ½ parted at scarf
Average	27170	34170	10.2	7.4	6.5	

Cold-Bend Test. A slight crack could be distinguished in sample No. 4 before beginning the test. Using an 11-lb. hammer, at the second blow, cracks showed plainly and the bend was 5 deg. By the 42nd blow the cracks had deepened and the bend increased to 90 deg. The sample broke at the center of the weld on the 56th blow. Most of the bending took place in the soft metal of the plate outside the weld. A crack about ⅛ in. deep was shown by discoloration due to oil that entered during machining. The balance of the fracture was made up of small crystals—free from blowholes, slag inclusions, laminations and other defects.

Hot-Bend Tests. Sample No. 2 was heated at the weld to a bright orange and struck by a 6-lb. hammer. At the 7th blow the coupon was bent through an angle of 45 deg. and cracks were plainly visible. It was heated a second time and bent down flat. The cracks which were short and about ⅛ in. deep did not extend entirely across the weld.

---

*Appendix No. 1 to a paper entitled "Some Principles of the Construction of Unfired Pressure Vessels," presented at the meeting of the American Society of Mechanical Engineers, Atlanta, Ga., May 8 to 11, 1922.

†Research Engineer, Linde Air Products Co., Member A. S. M. E.

In general, the weld is made up of the first filled area which has been annealed by the heat produced by welding up the opposite side. The last side welded shows the characteristic

These welds contain occasional inclusions at the bottom of the "V" and near the surface of the weld. However, they are relatively clean welds. The serious defects are the cracks which were exhibited by both specimens examined on each side of the weld.

Comparison of the chemical analyses of the weld and the original rod shows that there was practically no loss of nickel, about half of the carbon and manganese were oxidized and almost all of the silicon was burned out.

Per cent	Carbon	Manganese	Silicon	Nickel
Original rod	0.24	0.62	0.21	3.11
Weld	0.13	0.36	0.03	3.21

The ½-in. plate, 19 in. by 20 in., contained 0.07 per cent carbon, 0.50 per cent manganese, 0.04 per cent silicon, 0.058 per cent sulphur and 0.017 per cent phosphorus.

Specimen D was welded by the Rochester Welding Works and tested by the Electro Metallurgical Company. The history of this plate is as follows:

It was flat at both ends before starting and was welded on the first side with a No. 7 Davis-Bournonville tip (44 drill) in 40 minutes using a 72-in. 3/16-in. rod while in a similar time the other side was welded with a No. 8 D-B tip (40 drill) and a 81-in. 3/16-in. rod. The first side was left open 3/32 in. at starting end and 1/8 in. at finishing end before welding. Finishing end 1/16 in. open at completion of welding first side. Scale on bottom pickled off easily before welding second side. The second side was welded the day after the first side, but the entire length of the weld was warmed up to splitting heat before welding as the metal was very cold. The welding of the second side was begun at the same end as the first side. After first side was welded, the starting end was 1/16 in. concave on other side. After the second side was welded, the starting end was 3/32 in. concave on second side, finishing end was 1/8 in. concave on the second side and 3/32 in. concave lengthwise on first side. The welds were then pickled in hydrochloric acid and examined with a three-diameter magnifying glass. No cracks or defects were found in or near the weld.

The plate was next cut up into testing samples at the machine shop of the Electro Metallurgical Co. Beginning at the side first welded, samples Nos. 1, 3 and 5 were used for tensile tests; No. 2 for hot bend; No. 4 for cold bend and No 6 for chemical analysis of the weld metal. Portions of the weld between these samples were also retained for metallographic examination, and before any testing, all welds were ground as flush with the plate metal as possible.

Tensile Tests: Samples Nos. 1, 3 and 5 were broken in the 100,000-lb. Olsen tensile machine and the following results were obtained:

	Lbs. per sq. in.		Per cent Elongation in		Per cent Reduction
Sample	Yield Point	Ult. Ten. Strength	2 in.	8 in.	of Area
1	30500	48100	13.5	26.0	4.5
3	30300	47250	10.0	27.0	3.2
5	29100	49100	12.0	29.7	2.9
Average	30000	48150	11.8	27.6	3.5

Elongations and reductions of area taken at weld, regardless of where break occurred. The breaks were all approximately 2 in. outside the weld. Checks appeared in welds particularly at edges.

It should be observed that in every case the break occurred outside the weld in the plate metal. Cracks had begun to develop when the break occurred and the weld would probably have broken under a strain 50,000 lb. per sq. in. However, in its original built-up condition, the weld was decidedly stronger than the plate.

Favorable values for elongation were obtained, which of course is due to the extremely ductile plate material, while the reduction of area of the weld was very slight, which indicates that practically all the elongation took place outside the weld metal.

Hot-Bend Test: The sample was clamped in a vise with the weld about 1 in. above the edge and heated locally at the weld to bright orange color. A 6-lb. hammer was used. No crack could be observed when the sample was bent 60 deg. and at the third blow, at a 90-deg. angle, the first crack appeared. At the ninth blow the edges were brought together. The crack was about 1/8 in. deep at the edges but did not extend entirely across the weld.

Cold-Bend Test: This test sample was clamped in a vise and bent by striking with an 11-lb. hammer. It could not be broken or even severely cracked by this treatment. This was largely due to the fact that the weld was so much stiffer than the plate metal that little bending could be caused to take place in the weld. However, it should be borne in mind, in this connection, that had there been cracks or other serious defects in the weld it would have broken there.

Chemical analyses showed the following compositions:

Per cent	Carbon	Manganese	Silicon	Nickel
Original rod	0.24	0.62	0.21	3.11
Weld	0.12	9.38	0.05	2.83

The samples set aside for macrostructure examination were polished and etched with Humphrey's copper ammonium chloride reagent.

Before examination of the two samples for microstructure, they were reground and etched with a 10 per cent nitric acid in alcohol solution. It was found that the nickel weld metal had been normalized on both sides of the weld at this point in the process of welding and a sound union along the "V" was distinctly discernible. In both samples examined, one side was quite free from impurities while the other contained numerous defects although only two very slight cracks, or perhaps minute seams caused by laps in the metal, could be observed. The method of welding apparently left a greater portion of the weld in a normalized condition than is usually the case.

Specimens E and G were welded at the Newport News Ship Building & Dry Dock Co. through the courtesy of H. I. Walsh, welding supervisor and tested at the University of Rochester.

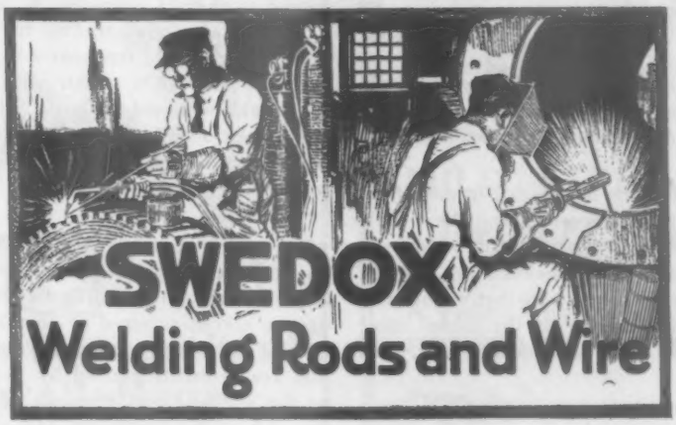
Specimens F, H, I and J were ½-in. plates of open annealed American ingot iron, welded and tested by the American Rolling Mill Co. In addition to investigating the qualities of 3.5 per cent nickel steel for gas-welding rods, comparisons of nickel steel and Armco iron welding rods were made. All welds were of the 90-deg. double "V" type and were machined flush before testing. Specimens F and J were gas and electric welded respectively with Armco wire, while specimens H and I were electric and gas welded respectively with nickel-steel wire. Standard Armco iron electrodes were used electric welds and standard Armco oxy-acetylene wire for the gas welds. The same nickel-steel wire was also used for both gas and electric welding.

Table 2. Results of Tensile Tests.

Specimen	Sample No.	Tensile Strength Weld	Tensile Strength Plate	Per Cent Reduction of Area	Per Cent Elongation in 8 in.	Location of Fracture	Remarks
F	1	42,570[1]	42,570	61.15	21.9	plate	
(Gas welded	3	43,850[1]	43,210	63.4	25.9	plate	
with Armco	5	41,550[1]	43,040	61.5	24.0	plate	
wire)							
H							Broke in "V" about
(Electric welded	1	39,330	.....	2.46	6.7	weld	⅛ width
with nickel steel	3	45,600[1]	45,830	67.95	21.9	plate	Rough
wire)	5	44,740	.....	3.63	11.8	weld	irregular fracture
I	1	41,900[1]	43,050	64.35	24.4	plate	
(Gas welded	3	42,650[1]	42,430	67.6	22.9	plate	
with nickel steel wire)	5	42,490	.....	.....	15.1	weld	Broke partly in "V"
J							
(Electric welded	1	40,850	.....	2.53	12.1	weld	
with Armco wire)	3	40,150[1]	44,150	73.7	22.5	plate	Crystalline
	5	40,400[1]	43,670	70.9	22.2	plate	good fracture

NONOX SWEDOX
LEKTROX SWEDOX
GAS CARBOX
ARC CARBOX

VANOX
NICKOX
KROMOX
RAILOX
CASTOX



SQUARE □ CASTOX
MANGANOX
ALUMINOX

BRONZOX
BRAZOX
TOBIN BRONZE
COPPER ALLOY RODS

COATED ELECTRODES

CASTOX-BRONZOX
ALUMINOX FLUXES.

SWEDOX welding wires and rods can be supplied immediately from stock, conforming in all respects to:

American Welding Society Specifications E No. 1-A; E No. 1-B; E No. 1-C; G No. 1-A; Folios No. 1-E and No. 1-G; and many others. We can furnish a welding wire or rod for any purpose and of any analysis required.

PUT YOUR WELDING TROUBLES UP TO US Let us prescribe the filler best adapted for your requirements. We maintain a research department conducted by experts for the benefit of our customers. This service is FREE OF CHARGE.

FLUXES—CASTOX, BRONZOX and ALUMINOX FLUXES when used with the corresponding non-ferrous filler rod will keep impurities out of the weld and promote thorough fusion.

FREE trial samples of any product will be furnished upon request. A trial of any SWEDOX product will convince you of its superiority. Send for these samples NOW.

CHICAGO, ILL.
127 N. Peoria St.

Central Steel & Wire Company

DETROIT, MICH.
Warren & Bellevue Aves.

CESCO HELMET

Door hinged at arrow, all helmets are fitted with

Essentialite Lenses

Style "P"

Sold by All the Leading Jobbers of Equipment
Manufactured by

CHICAGO EYE SHIELD CO.
2300 WARREN AVE., CHICAGO, ILL.

AUTOMOBILE WELDING

With the OXY-ACETYLENE FLAME By M. Keith Dunham

167 Pages* Price $1.50 *Fully Illustrated

This is the only complete book on the "Why" and "How" of Welding

Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone.

Gives principles never to be forgotten. Aluminum, cast iron, steel, copper, brass, bronze and malleable iron are fully treated, as well as a clear explanation of the proper manner to burn the carbon out of the combustion head.

Automobile Owners, Garage and Service Stations, Blacksmiths and Machine Shops, as well as industries using the oxy-acetylene flame, will find this book of the utmost value, since the perplexing problems arising when metal is heated to a melting point are fully explained and the proper methods to overcome them shown.

CONTENTS

CHAPTER I.—APPARATUS KNOWLEDGE.
Oxygen Supply—Care of Oxygen Cylinder—Acetylene Generation—Care of Generator—Regulators—Care of Regulator — Creeping Regulators — Gauges—Care of Gauges—Welding Torch—Care of Welding Torch—Effects of Heat—Hose and Goggles.

CHAPTER II.—SHOP EQUIPMENT AND INITIAL PROCEDURE.
Preheating Agencies—Welding Table—Location of Welding Outfit—Starting the Welding Outfit—Adjustment of Flame—Principle of Welding—General Welding Knowledge—Welding Rods and Fluxes—Choice of Tip—Expansion and Contraction.

CHAPTER III.—CAST IRON.
Simple Welding—How to Hold the Flame—Hard Cast Iron—Pin Holes and Blow Holes—Lug on Cylinder—Water Outlet—Cylinder Welding—Compression Head—Finishing and Testing—Scored Cylinders—Cylinder Parts—Fly Wheels—Pistons—Crank Cases — Babbitted Bearings — Valve Guides—Preserving Threads—Conclusion of Cast Iron.

CHAPTER IV.—ALUMINUM.
Use of—Welding Knowledge—Puddle System—Flux System—Comparison of Systems—Welding Rod—Preparation of the Weld—Inlet Manifold—Arm of Crank Case—Welding the Arm Without Taking Out the Motor—Break in the Body of Case—Welding Cold—Wrong Method of Setting Up—Lug or Boss Welding—Preheating the Case—Gas Preheating Flame—One Side or Both—Collapse of Weld—Broken Bearings—Direction of Welding—Shrinkage Cracks—Missing Parts—Finishing—Die Moulded Castings—Body—Other Parts.

CHAPTER V.—STEEL.
Welding Knowledge—What the Flame Does to Steel—The Welding Rod—Simple Welding—Position of Flame—Reinforcing the Weld—Frame Welding—Lengthening the Chassis—Tube Housings—Worn Parts—Gear Welding — Case Hardening — Light Metal Welding—Gasoline Tank—Welding Adjacent to Rivets—Shaft Welding—Construction of Parts.

CHAPTER VI.—MALLEABLE IRON, COPPER, BRASS, BRONZE.
How to Detect Malleable Iron—Brazing Malleable Iron—Rear Housing—Reinforcing the Braze—Brazing Tube to Housing—Building Up Worn Parts—Copper—Brass and Bronze—Silver Soldering.

CHAPTER VII.—CARBON BURNING AND OTHER USES OF OXYGEN AND ACETYLENE.
Principle of Carbon Burning—Method of Operation—Lead Burning—Soldering—Case Hardening—Heating Uses.

CHAPTER VIII.—HOW TO FIGURE COST OF WELDING.
Oxygen Consumption—Dissolved Acetylene Consumption—Torch Consumption Test—Acetylene Generator Consumption—Cost Card—Conclusion.

Sent to any address Postpaid on receipt of $1.50 THE WELDING ENGINEER 608 So. Dearborn St. CHICAGO ILLINOIS

[1]Not maximum or breaking strengths as fracture occurred outside of weld and the maximum stress on the original plate to the basis of the cross-section of the weld. These welds may have been stronger but no weaker because they stood that stress without fracture in the weld. The differences in unit stresses on weld and plat is due to difference in measured cross-section.

Tensile Test: The results are shown in Table 2. Yield points are not given because of unreliability in case of electric welds and no yield point determined with oxy-acetylene welds.

The above results show that there is practically no difference in the tensile strength of the Armco iron and the nickel-steel wires for oxy-acetylene welds. For electric welds the tensile strength is somewhat greater for nickel steel, though the per cent elongation is somewhat less. In this connection it should be stated that the weldability of the nickel steel for electric welding is very poor. The arc sputters badly and is very difficult to control.

Hot-Bend Test: Samples were heated by a large gas-blast torch to a bright orange color about 2 in. on each side of the weld. They were then placed in a vise and bent about 120 deg. at the weld by means of 4-lb. hammer blows. They were next removed, laid on a concrete floor and bent to 180 deg. or flat on themselves. The operations were performed as rapidly as possible so that the samples were still cherry-red upon completion of test.

Cold-Bend Test: The proposed standard procedure for the mechanical testing of welds of the American Welding Society was followed. (See Bulletin No. 1, Standards for Testing Welds, American Bureau of Welding.) A tensile testing machine with a special bending fixture was used. The results of the cold- and hot-bend tests are given in Table 3.

Table 3. Results of Cold and Hot-Bend Tests.

	Electric		Oxy-Acetylene	
Cold-Bend Test	Armco	Nickel	Armco	Nickel
Cross-sectional area, sq. in.	0.748	0.703	0.843	0.852
First noticeable fracture angle, deg.	30	20	12	13
Load, lb. per sq. in.	7650	6860	6840	7700
Max. or complete fracture, angle, deg.	46	20	67	53
Load, lb. per sq. in.	7810	6860	12,750	13,680
Remarks	One plate thicker	First fracture was max.	Only one side weld fracture	
Hot-Bend Test				
Total number of blows to flat and fracture	27	16	20	15
Reheated	after first 21 blows	no	after first 14 blows	no

On the cold-bend tests of the electric welding the Armco welds are somewhat stronger as well as more ductile than the nickel-steel welds, while on the oxy-acetylene welds the nickel steel shows greater strength but the Armco welds were considerably more ductile. In the hot-bend tests the Armco iron welds required the most blows to cause fracture.

Chemical Analysis: Results showed that both the carbon and manganese largely burn out during the welding process whether it is electric or oxy-acetylene.

Per cent	Carbon	Manganese	Nickel
Original wire	0.22	0.69	3.49
Weld	0.14	0.297	3.29

Samples of the welds were examined macroscopically and they appeared sound in all cases. A cross-sectional view of the welds after macro etching gave the following information:

Armco oxy-acetylene weld shows well-developed grain structure, small and uniform. Small dark inclusions are characteristic of oxy-acetylene. Nitride needles near one surface are plainly evident.

Nickel-steel oxy-acetylene weld has grain fine on one side, very uniform and well-defined structure. On the other side the grain is indefinite and irregular, showing more or less of a columnar structure.

Armco electric weld is the usual structure characteristic of its kind.

Nickel-steel electric weld is also characteristic structure, although the columnar formation is more pronounced than ordinarily under 100 diameters.

Probably the most interesting case of the ten specimens tested is that of specimen B, in which cracks were found in the plate at a distance up to ¾ in. from the edge of the weld, which could frequently be seen with the naked eye and which were readily visible with a magnifying glass (Fig. 7). It should be noted that the plate had not been fused where the cracks occurred. Examination was made of these cracks by taking a section through them and examining under the microscope.

The pieces so examined were taken from another test plate made in the same steel and in the same way, the test pieces having been strained in a 50,000-lb. testing machine, which was not sufficiently strong to break them, but which did open up the cracks referred to so that they could be seen. These cracks apparently only occurred on the second side welded and are probably caused by the resistance to shrinkage due to the stiffness and strength of the plate, although the poor general quality probably had also a considerable effect. I had never noticed such cracks before, although I have since found them in sheet material of poor quality.

Microscopic examination of the section taken through one of these cracks is very interesting. The plate, as received, was quite heavily coated with mill scale, which had been rolled into the surface. This is brought out by the pickling. An examination of the weld with a hand glass shows quite clearly that this mill scale has been fused in the vicinity of the weld. Of course the temperature of the plate near the weld was high, probably 2300 deg. Fahr. or 2400 deg. Fahr. which would be sufficient to melt the scale. Also the plate at that temperature was in the γ range.

At this high temperature the crystallization of the metal is different from that at room temperature in that the grains are of different shape and larger, and that the carbon is all in solution in the iron. The weld having been made on one side, the plate is rigid and the expansion due to the heat compresses the metal where it is weakest, that is, hottest, and when it cools, the contraction occurs at the same place. If the strain is great enough, the plate cracks if it is not sufficiently ductile. If the metal were of poor quality, and brittle at high temperature, the condition would be worse. In either case, capillary attraction might draw the melted scale into the cracks.

At this high temperature the solvent power of the iron for impurities is considerable, and it is quite reasonable to suppose that some of the mill scale was dissolved. As the metal cools, some of the oxide would fall out of solution, and be rejected to the grain boundaries then existing, that is the austenite or γ ones. Even if this did not occur, the strain might cause minute cracks, the surfaces of which would oxidize easily. Whatever occurred, the recrystallization that occurred later in the cooling, when the metal passed from the γ to the α condition, could not pass these impurities, which outlined the γ grains, and which, when the metal was cold, showed their location.

It is well known that tool steel, when burnt, shows such markings around the grains, these being sharply angular, instead of being rounded as the alpha grains are. I sectioned one of the pieces through one of these cracks in the plate, and in examining it at low power, I noticed a net work which did not coincide with the α grain boundaries. Higher power showed it to be apparently a film of oxide. Still higher power seems to confirm this.

Microphotographs were made showing the structure. The network is quite extensive, being near the large crack which is the result of the tensile test of the material. I have no doubt that originally this crack was not much larger than the network.

A section from sample No. 1 of specimen B showed no cracks in the plate, but some few in the weld, which were about 1/200 in. deep. In some cases, it appears that these cracks pass through the center of particles of cementite.

"Quality Protects Profits"

TORCHWELD

Reg. U. S. Pat. Off.

Non-Flash Apparatus

Unequaled Records for Success and Size of Installations!

The high standing TORCHWELD enjoys in the iron, steel and metal working industries has been earned—only as such things can be earned—by giving downright good value!

TORCHWELD patented construction provides many advantages, invaluable to the welding and cutting of metals.

Equal Consumption of Oxygen to that of Acetylene for welding.

Equal Gas Pressures for Welding, and lower pressures than usual for cutting.

Freedom from flash-backs—regardless of the size of the welding or cutting job, — gases properly mixed *beyond* heat radius of the work.

Positive safety, whereby any attempted flame propagation into the welding or cutting torch is expelled.

Consider also that TORCHWELD welding torches are machined from solid bar brass stock, and that principal parts of the cutting torches are similarly made; all permanent joints are brazed. Heavy duty welding tips are machined from solid bar copper stock, and are sufficiently heavy to make them sturdy, long wearing, and free from seating troubles. TORCHWELD torches are as well balanced as the beam on a scale; they do not tire the operator.

A comparison of qualities and prices will reveal values you will eventually require and demand in torches, regulators, and general welding and cutting equipment.

Buy Torchweld Now!

Torchweld Equipment Company

Fulton and Carpenter Sts., Chicago, Ill.

"RACO"

MILD STEEL ELECTRODES for ELECTRIC WELDING

A general purpose wire, guaranteed to conform with the following specifications:

Penna. R. R.	Specification No. 156A
B. & O. R. R.	Specification No. 191D
C. P. R. R.	Specification No. 106
N. Y. N. H. & H. R. R.	Specification No. 161
U. S. Navy Dept.	Specification No. 46S10a

Also furnished dead soft annealed.

"RACO" COVERED ELECTRODES FOR ELECTRIC WELDING

"RACO" Covered Electrodes are used with either alternating or direct current where bare wires will not give satisfactory results.

"RACO" IRON ELECTRODES FOR ELECTRIC WELDING

This wire may be used with success wherever imported Norwegian or Swedish wire has been considered necessary.

"RACO" MILD STEEL RODS FOR OXY-ACETYLENE WELDING

Copper Coated

Answers the usual railroad, shipyard and industrial requirements as are allowed by authoritative regulating bodies such as the American Bureau of Shipping, the Interstate Commerce Commission, etc.

Blue Label

Colored labels in this style identify each different kind of RACO WIRE

Samples for testing and descriptive booklet sent promptly

REID-AVERY COMPANY

21st Street and Washington Avenue

Philadelphia, Pa.

Whether the cementite was actually ruptured or not is a question, although I am inclined to think that it was. It is, of course, possible that the main part of the crack occurred at high temperature and that it extended at a lower temperature. These cracks are very small, and have no apparent effect on the strength of the welded piece, because even when the welds were ground down level with the plate, the plate broke in the middle third between the weld and the shoulder in a natural, normal manner.

These cracks are also very shallow, and most of them are filled with oxide, showing that they occurred at high temperature. The weld scale is very adherent, requiring for its removal much longer pickling in dilute hydrochloric acid than ordinary weld scale. It appears to run down into the cracks as a continuous part of the surface scale in some cases, and there are in the surface scale particles of metal.

There was also made a section of the scale and metal which illustrated well the interlocking of the two, and the reason for the difficulty in pickling it off. The scale also has a structure which I am not able to explain. It therefore might be a wise precaution in some cases to grind from the weld, the scale and a small portion of the metal, to remove such surface cracks as might exist.

Sample No. 2 of specimen B appeared from general observation not to be of good steel. The fractures in the tensile test pieces were not silky as they should be, but were more or less harsh to the eye. It is worth noticing that welds made with nickel-steel wire, in 64,000 lb. plate, the welds being reinforced the usual amount, broke the plate outside the weld with the same necking down as would be expected in an ordinary tensile test.

Leaving aside for the moment the question of welding, it would seem that we must pay much more attention to the quality of the steel used for welding than we have in the past. This brings up the question of some of the mysterious failures of boiler shells, ship plates, etc., and I am inclined to believe that much of the trouble has come from defective steel, the defects have not been detected, and they probably could not be detected, by any ordinary examination, or the regular tests.

There was, for instance, the quite noted case[1] of the plate failures on a ship being built in England, which gave trouble from brittleness after having passed all Lloyd's tests successfully. This case was investigated by some of the ablest metallurgists in England, and the consensus of opinion appeared to be that the plate was from a basic-open-hearth heat that had not been properly treated with manganese and was otherwise badly made.

Attention was called to the remarkable angularity of the grains. It was found by analysis that the steel was very high in oxygen and nitrogen. Analyses were made by a number of chemists, and the results not only showed the above, but that the steel was badly segregated. While the standard tests did not show anything wrong with this material, alternating-stress tests did show clearly that the metal was inferior, and the matter is referred to, not with the idea of trying to include such tests in specifications, but to show that at times more searching tests than the usual ones may be needed.

In many other cases in the literature this same angularity of grain is noticed in photographs, even if no reference is made to their shape in the text, so that angular grains would be indicative of poor material. It would seem that they represent the γ grain boundaries, and not the α ones.

I do not doubt that invisible intergranular films may exist along the γ grain boundaries in many cases, which would open paths for oxidation when heated or which under severe strain might result in rupture, particularly if the strain were accompanied by shock. I am convinced that such is the case in welds, because I have broken many pieces under the microscope, and even when there was no evidence of intergranular films at 1200 diameters, the rupture was generally along what are apparently the γ grain boundaries.

There are three classes or qualities of steel plate, called flange, firebox, and tank. The specifications[2] of the American Society for Testing Materials for the first two are given in Table 4.

Table 4. Specifications of A. S. T. M. for Flange and Firebox.

Kind of Steel	Flange	Firebox	Remarks
Carbon, per cent	.....	0.12 to 0.25	Plates ¾ in. thick or less
Manganese, per cent	0.30 to 0.60	0.30 to 0.50	Plates ¾ in. thick or less
	0.30 to 0.60	0.30 to 0.60	Plates over ¾ in. thick
Phosphorus, per cent	0.05 max.	0.04 max.	Acid
	0.04 max.	0.035 max.	Basic
Sulphur, per cent	0.05	0.04	
Tensile strength	55,000 to 65,000	52,000 to 62,000	Lb. per sq. in.
Yield point	0.5 ten. strength	0.5 ten. strength	
Elongation in 8 in.	1,500,000 ten. strength	1,500,000 ten. strength	Minimum per cent

Steel of tank quality has no specification. It may have as high as 75,000 lb. tensile strength and be full of impurities, and is entirely unfit for important work. It is made from heats that for some reason are off.

Firebox steel is evidently of better quality from its composition, having less phosphorus and sulphur. But there are further differences that are hard to describe, and which are usually known only to the mill. For much work flange quality is plenty good enough, while for the better work, firebox quality is needed, but in my judgment the tensile strength and carbon are too high in the A. S. T. M. specification for really important work, and the specification proposed earlier in the paper I believe to be much more suitable. In any case, high quality is essential to the best work, and for such work firebox steel should be specified.

This matter of quality, as distinguished from chemical composition, has been referred to at some length, because my experience has been that it affects the quality of the weld. This is especially true where the metal contains notable amounts of what Brearley calls "mechanical dirt." It is coming to be believed more and more that oxides of various kinds are largely responsible for the poor quality of steel, and I have found that steel containing this dirt foams and spits during the welding, and that the welds made in it are weak. Of course all steel plate contains some impurities, and it is very hard to say how much to allow, or how to draw a specification limiting the amount. But steel of firebox quality never gives any trouble, as far as I know, and I believe that we will be safe if we specify it for important work.

The superficial cracks in the nickel-steel welds referred to are not found in all cases. They are rare in welds made with ordinary materials and their presence is not fully understood.

The important thing is to provide a weld that will be sufficiently strong even when somewhat defective, and the base metal so weak that it will take the strain in preference to throwing it in the weld. I do not believe that these minute cracks in nickel-steel welds are any different from those occurring with ordinary welding material. This is not saying that welds free from them are not desirable because they are, but nickel steel should not be condemned on this ground alone, any more than should ordinary welding material, because the cracks have occurred in both.

The cracks in the plate of specimen B are of particular interest, because they show necessity of having the base metal of such a quality as will not be injured during the welding, and it is significant that none of the other plates had them, though they were looked for very carefully. We must not forget that special materials have had to be developed for specific processes, for instance, the use of bessemer

[1] *The remarkable failure of a consignment of ship plate, by J. B. Wilson. Proceedings of Engineers and Shipbuilders in Scotland, 1914, p. 227.*

[2] *A. S. T. M. Specifications* 1921, *p.* 230.

steel is general for screw-machine stock, because the chips from it break up readily and do not clog the tools. In the same way, we must have for welding purposes a steel that meets the requirements. Fortunately, such steel is not difficult to obtain, and the steel maker will be glad to furnish it if he knows what the requirements are, and it is our business to advise him of them.

Any welding wire used must be of good and uniform quality if good results are always desired. I have found very bad results from some nickel-steel rod. I cannot say yet where the trouble lies, but it does not appear to be entirely dependent on the chemical analysis, and I have no doubt that the general quality of it and other wires will be found just as important in all cases as I know it is in some.

It should be clearly understood that I do not believe nickel steel to be the best welding material that can be made. I have had great success with it, and it is to my mind the best material now readily available for high-strength welds. But I would be glad to see other wire giving similar high strength, because it is very probable that still better qualities can be obtained by other alloys than nickel. It is just as important to have suitable wire for welding pressure vessels, as it is to have suitable plate, and if our needs are realized, they will be met.

I feel very strongly that some method of protecting the weld from the action of oxygen in the air or in the welding flame must be used, if we want the highest efficiency. I do not mean that we cannot make safe pressure vessels now, because we can and it is being done every day, but we want to do better.

The following general conclusions may be drawn from these tests:

a If the weld is ground to the same thickness as the plate, the break will probably occur outside of the weld.

b Since all welds not ground flush broke outside of the weld, it is highly improbable that any double "V" welded piece of low-strength plate and properly reinforced will break in the weld.

c Bare-wire arc electric welding is not practical with a nickel-steel rod.

d Arc welds made in low-strength plate with proper electrodes and reinforced will always break the plate under tensile test.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of The Welding Engineer, published monthly at 608 S. Dearborn St., Chicago, Illinois, for October 1, 1922.

State of Illinois, County of Cook, ss.

Before me, a Notary Public, in and for the State and County aforesaid, personally appeared L. B. Mackenzie, who, having been duly sworn according to law, deposes and says that he is the Publisher of The Welding Engineer, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, L. B. Mackenzie, Chicago, Ill.; Editor, L. B. Mackenzie, Chicago, Ill.; Managing Editor, L. B. Mackenzie, Chicago, Ill.; Business Managers, L. B. Mackenzie, Chicago, Ill.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) The Welding Engineer Publishing Company. L. B. Mackenzie, 7131 Crandon Avenue, Chicago, Ill.; M. J. Hungerford, 6107 Dorchester Avenue, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is..... (This information is required from daily publications only.)

L. B. Mackenzie,

Sworn to and subscribed before me this 29th day of September, 1922.

(Seal.) William Derbach.

(My commission expires April 7, 1925.)

SALLWELD
ASBESTOS PAPER

SAL-MO PRODUCTS
Trade Mark

In rolls 36 inches wide weighing approximately 100 pounds each.

SLOWS UP COOLING PROCESS

No obnoxious or injurious fumes.

KEEPS DIRT OUT OF WELD.

Manufactured by
SALL MOUNTAIN COMPANY
140 So. Dearborn Street Chicago, Ill.
Eastern Office, Scranton, Pa.

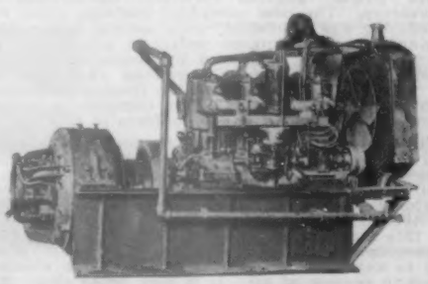
Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Acetylene Cylinders Bought and Sold—I can save you money on the purchase of Prest-O-Lites and other acetylene cylinders or will help you if have any to dispose of. Robt. B. Dyar, 140 S. Dearborn St., Chicago, Ill. t.f.

USED GASOLINE DRIVEN EQUIPMENT

1 Electric Welding Co. of America GASOLINE Driven Outfit, self-contained in steel frame, capacity 160 amp., max. voltage 60 v., 700 r.p.m., 4 cyl., 6x6, vertical automobile type gasoline engine with Bosch magneto,



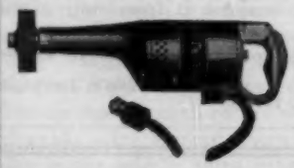
Stromberg carburetor, fan and large radiator. Rebuilt like new.
Standard Electric Machinery Co., 7 E. Hill St., Baltimore, Md.

Position Wanted—10 years' experience, welding all metals. Expert on aluminum. Can repair generators and equipment. Have done all the estimating on jobs for one of the largest welding companies in Ohio for the last four years. Can furnish references. Address 52, care The Welding Engineer.

Position Wanted—By all around acetylene welder. 18 years' experience as auto mechanic, including 6 years welding. At present employed as foreman. Address 53, care The Welding Engineer.

Position Wanted—Welding demonstrator. 4 years' experience as oxy-acetylene welder in one of the largest shops in the middle west. Address 54, care The Welding Engineer.

For Sale—At reasonable price, two slightly used G. E. latest type, automatic welders, with flexible attachments to make same semi-automatic; 50 to 75 volts, 25 to 300 amperes, complete with panel control. Apply Purchasing Agent, American Motor Body Company, Philadelphia, Pa.



Every Welding Shop Needs a "WODACK"

WODACK *Portable Electric Drills and Grinders* pay their own way by cutting down the time on necessary operations. Drilling and grinding in out of the way places is accomplished in a jiffy—and with ease. The investment is fully protected by the WODACK guarantee.

"ELECTRIC DRILL FACTS" is a booklet that tells all about it. Write for your copy today.

WODACK ELECTRIC TOOL CORPORATION, 43 S. Jefferson St., Chicago, Ill.

ATTENTION, WELDERS

Make big money repairing Scored Cylinders and Cracked Water Jackets by the EVER STAY PROCESS. We GIVE you complete instructions on making tools and applying EVER STAY METAL with an initial order of EVER STAY METAL AND FLUX.

EVER STAY METAL ..... $2.75 Per Pound
EVER STAY FLUX ..... 1.00 Per Bottle
EVER STAY SOD LOOM, for Aluminum ..... 2.75 Per Pound

This metal sold on a Money Back Guarantee. All orders shipped C. O. D. No orders shipped less than two pounds of metal.
Prices F. O. B. Omaha, Nebr. Jobbers wanted in every city.

ROBT. B. DYAR,
140 S. Dearborn St., Chicago
Eastern Distributor

EVER STAY SALES COMPANY
1501 Jackson Street, OMAHA, NEBRASKA

CURRENT WELDING LITERATURE

FUSION TESTS TO DETERMINE THE SUITABILITY OF VARIOUS MATERIAL FOR WELDING PURPOSES, by J. H. Nead and R. L. Kenyon—This paper is a progress report of the American Welding Society Committee on specifications for steel to be welded. It describes a method whose purpose is to test the suitability of various material for welding purposes. The photographs included in the report give striking evidence of the difference in behavior under fusion between various kinds of steel and iron. The tests so far reported indicate that iron which is free from impurities fuses sharply without gas evolution and sparking, and flows freely when molten. On the other hand, the samples which contained impurities of various sorts showed a marked tendency to boil and bubble near the fusion point. The tests have not, however, proven that such action is evidence that the material in question cannot be satisfactorily welded.—Journal of the American Welding Society, October, 1922.

CUTTING MANGANESE STEEL, by Z. T. Davis—Manganese scrap is usable only at a manganese steel foundry, and on account of the manganese contained, it has considerable value as scrap. The oxy-acetylene cutting torch is shown to be a valuable tool for reducing scrap, cutting off risers and cleaning castings.—Journal of the American Welding Society, October, 1922.

SOME RECENT DEVELOPMENTS FOR RESISTANCE WELDING, by H. A. Woofter—A general discussion on the application of resistance welding to production work. Special emphasis is laid on the adaptability of the process to welding such alloys as stellite, brass, duralumin and alloy steels.—Journal of the American Welding Society, October, 1922.

THERMIT LOCOMOTIVE PAMPHLET NO. 21—This is the fourth edition of this pamphlet which is issued by the Metal & Thermit Corp., and is of special interest to superintendents of automotive power, general foremen, blacksmith foremen and thermit welders. The new pamphlet contains many revisions since the last edition was published, chief among which are instructions for applying important improvements in practice in thermit welding, which have been developed by research. The drawings and instructions illustrating and describing the making of thermit welds in various parts of locomotive frames and other locomotive and railroad equipment have been completely revised since the publication of the last edition, to conform to the improved practice.

UNFIRED PRESSURE VESSELS, by S. W. Miller—A report presented to the annual meeting of the International Acetylene Association on behalf of the Technical Committee. The report points out the present danger of legislation unfavorable to the use of autogenous welding in the construction of pressure vessels, and describes certain tests which are being made with the view to offset this legislation. The author points out that the fundamental question is not whether we shall weld pressure vessels according to any particular person's ideas, but whether we should weld pressure vessels at all. It is also made clear that the active and wholehearted co-operation of everyone interested in the welding industry and in the construction of pressure vessels by welding is necessary.—Acetylene Journal, November, 1922.

PREPARING THE WELD, by David Baxter—A discussion of the necessity for careful preparation before starting to weld, showing the benefits of beveling and the methods of doing it.—Acetylene Journal, November, 1922.

THE WELDING OF BOILER PLATES AND BOILER DETAILS, by D. Richardson—A description of methods used to estimate the value of autogenous welding as applied to the fabrication of boilers. Detailed description with diagrams is given of the tests carried out sometime ago by the Swiss Society of Steam Boiler Owners. These tests show the welds to have an average tensile strength of 84%.—Acetylene & Welding Journal, London, October, 1922.

WELDING CAST IRON, by A. S. Kinsey—Continuation of a previous article on the subject. This portion of the discussion deals with the hardness and strength of cast iron, and the grain structure. This is followed by a description of various types of malleable cast iron, and the method of repairing broken malleable casting by brazing.—Railway Mechanical Engineer, November, 1922.

RESISTANCE WELDING, by A. L. DeLeeuw—A technical description of what takes place in the making of a resistance weld. Shows the conditions necessary for good welding, how the amount of current is determined, how the contact is made, what the necessary parts of a resistance welder are, and explains the theory of the heating process.—American Machinist, November 9th, 1922.

RECLAMATION BY THE OXY-ACETYLENE PROCESS, by A. F. Dillon—A general discussion of the directions necessary to be observed in order to secure the best results, such as accuracy in alignment preheating and annealing, proper fusion of metals, selection of welding rods, and system in handling the work.—Railway Purchases & Stores, November, 1922.

MATCHING THE WIRE WITH THE WORK, by E. Wanamaker—A brief general discussion of the necessity for welding materials of different composition to make possible the production of welds of various characteristics. It is pointed out that the service requirements rather than the composition of the base metal are the determining factors in the selection of electrode material, although the general practice has indicated that good results have been secured when the electrode was similar in character to the base metal.—Acetylene & Welding Journal, London, October, 1922.

ADVERTISING BALLOONS USE HYDROGEN GAS

During the Indiana State Fair, which was held in Indianapolis the week of September 4th, one of th unique events was a new kind of balloon race. Sixteen mammoth balloons were released at the fair grounds, each of them carrying a telegram blank addressed to the Indianapolis Chamber of Commerce. The finder of the balloon was instructed to send the telegram to the Chamber of Commerce. A map was also enclosed in the balloon which the finder was asked to mark with the location of the landing of the balloon, and then mail it to the Indianapolis Chamber of Commerce. Each one of the balloons carried an advertisement of an Indiana firm, and a prize of $50.00 was offered to the person who returned the balloon which had traveled the farthest distance from Indianapolis.

The accompanying photographs give an idea of the size of the balloons and the amount of gas necessary to fill them. Mr. J. R. Brandt, of the Indiana Oxygen Co., was on the job well in advance of the contest to see to it that hydrogen gas was used for inflating the balloons.

Hydrogen Gas Used in Balloons Which Formed an Interesting Feature of the Indiana State Fair.

ROL-MAN

MANGANESE STEEL
WELDING RODS

For Electric Welding — For Gas Welding

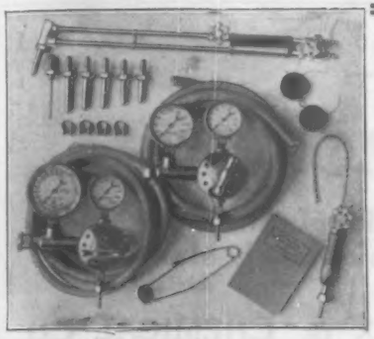
MANGANESE 12 to 15 Per Cent

Build Up a TRUE MANGANESE STEEL Wearing Surface with ROL-MAN RODS on Worn Manganese and Carbon, Crossings, Frogs, Switches and Track-work. Crusher parts, Dredge-Bucket Lips, Sprocket and Gear Teeth, Rolls, etc.

ROL-MAN MANGANESE for MAXIMUM WEAR

Standard Sizes and Lengths—Coated or Bare — Samples on Request

MANGANESE STEEL FORGE CO — PHILADELPHIA, PA.



No. 2 Superior Welding and Carbon Burning Outfit, equipped with double gauge regulators $69.20

No. 1 Superior Welding and Carbon Burning Outfit, equipped with single gauge regulators $49.10

Superior Oxy-Acetylene Machine Company

Manufacturers of
Welding and Cutting Apparatus, Torches, Regulators, Gauges. Lead Burning and Carbon Burning Outfits, Acetylene Generators. Welding Supplies of Every Description.

No. 2 Superior Welding and Carbon burning outfit consists of:

1 Superior Type "B" Welding Torch, passed upon by the Underwriters. This Torch is heavily nickel-plated, with metal handle, equipped with 7 two-piece copper Welding Tips. No. 1 tip can be used for Radiator Work. This Torch is a Non-Flash Torch and will not flash out under any ordinary circumstances		$16.00
1 Carbon Removing Torch		1.50
1 Safety Torch Lighter		.50
1 No. 30 Safety Front Oxygen Regulator with one 3,000-lb. Gauge, registering cu. ft. and one 300-lb. Gauge		24.00
1 No. 35 Acetylene Regulator, equipped with one 300-lb. Gauge and one 50-lb. Gauge		18.00
1 Length of 5-ply Oxygen Hose, 13½ ft.		$ 1.80
1 Length of 5-ply Acetylene Hose, 12½ ft.		1.50
4 Hose Clamps		.20
1 Pair Welding Goggles		.50
1 Instruction Book		1.00
1 Adapter		1.50
8 Cast Iron Rods 3 Brass Rods 8 Aluminum Rods 10 Steel Rods	1 Pound Cast Iron Flux 1 Pound Brass Flux 1 Pound Aluminum Flux	3.00
Price of Outfit No. 2		$60.20
Cutting Tip can be furnished for above Outfit to cut steel up to 2 in. in thickness		5.00
Packed in carrying case, extra		3.00

Repair all makes of equipment.
WRITE FOR MONTHLY PRICE SHEET AND CATALOG
Agents wanted in unoccupied territory.

Superior Oxy-Acetylene Machine Co.
Hamilton, Ohio, U. S. A.

This Mark on Welding or Cutting equipment insures efficiency, long life and satisfaction.

U.S.

Welding Plants, Cutting Apparatus, Lead Burning Outfits, Acetylene Generators, Welder's Accessories.

SEND FOR CATALOG

UNITED STATES WELDING CO., Inc. — MINNEAPOLIS, MINN., U. S. A.

WHATEVER YOUR QUESTION

Be it the pronunciation of Bolsheviki or soviet, the spelling of a puzzling word—the meaning of blighty, fourth arm, etc., this Supreme Authority—

Webster's New International Dictionary

contains an accurate, final answer. 400,000 Words, 2700 Pages. 6000 Illustrations. Regular and India Paper Editions.

G. & C. Merriam Co. Springfield, Mass.

Write for specimen pages, prices, etc., and FREE Pocket Maps if you name this publication.

DAVIS-BOURNONVILLE COMPANY
was merged with
AIR REDUCTION SALES COMPANY
on March 17, 1922

The Oxyacetylene Welding and Cutting products formerly manufactured by Davis-Bournonville Co. are now made and sold by Air Reduction Sales Co. under the trade name of "Airco-Davis-Bournonville" or "Airco-D-B."

(See advertisement of Air Reduction Sales Co.)

BOOKS ON WELDING

Write for list of books on welding.
If it's in print we have it.

THE WELDING ENGINEER
608 S. Dearborn St. — CHICAGO, ILL

Columbia

Round Welding Carbons
Welding Carbon Plates
Welding Carbon Paste
Welding Carbon Flour

Our welding carbon products are designed especially for welding operations

NATIONAL CARBON CO., Inc.
Cleveland, Ohio San Francisco, Calif.

CAST IRON RODS
MADE FROM PIG IRON
(NO SCRAP USED)

Approximating
3.00%—in Silicon (Result: A soft weld)
.60%—in Phosphorus (Result: Fluidity)
.02%—in Sulphur (Result: A clean weld)

Our Rods the Best by Test. Also Rods, Wires and Fluxes for Welding All Other Metals

Prices on Application

Bierman-Everett Foundry Co.,
133-153 So. 20th St., Irvington, N. J.

THE BUCKEYE WELDING & SUPPLY CO.

Crescent Welding Rod

Welding—**REGO**—Cutting Equipment

Welding Supplies Solder-Babbitt

1544-52 W. 6th St. CLEVELAND, O.

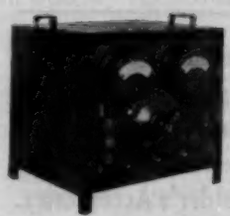
Price List on Request

Specify—
"MOREY"

A Moisture Proof Aluminum Flux
Stable, Economical, Marvelous

MOREY FLUX & CHEMICAL CO.
Parkesburg, Penna. U. S. A.
Est. 1912 Inc. 1915

QUASI-ARC SYSTEM

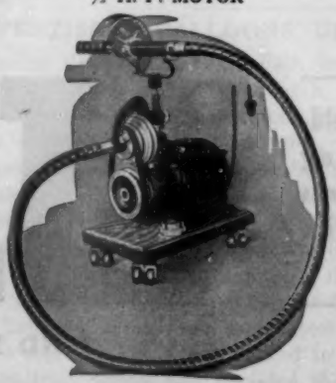


We Manufacture:
A. C. & D. C. Welding Sets
Also Weldtrodes for
Mild Steel
High Carbon
Manganese
Cast Iron

L. W. 110 V. WELDER Gives Machinable Weld

QUASI-ARC WELDTRODE CO., INC.
Peekskill, New York

TYPE M6
½ H. P. MOTOR



Strand
Trade Mark

GRIND Those Welds With
STRAND
Flexible Shaft Grinders
Thousands in Use

N. A. Strand Co.
CHICAGO
THE ELECTRICAL BLDG.
625 W. Jackson Blvd.

WELDING ROD HOLDERS
FOR THE OXYACETYLENE WELDER

75 CENTS EACH, 3 FOR $2.00
Dealers Price on Application

C. SORENSEN 18 EAST 16TH STREET CHICAGO, ILLINOIS

OXYGEN HYDROGEN
SEAMLESS STEEL CYLINDERS
I. C. C. SPECIFICATIONS

WM. WHARTON JR. & CO., INC.
30 Church Street NEW YORK CITY

IMPERIAL WELDING AND CUTTING EQUIPMENT
OXY-ACETYLENE PROCESS

A new mixing principle, a regulator that accurately controls gases, the greatest working range ever covered by ONE torch —are exclusive IMPERIAL features. Write for catalog.
Imperial Brass Mfg. Co., 517 S. Racine Ave., Chicago

"ALTERNARC"
CUTTING and WELDING

Machine that can be taken to the work. We will do immovable jobs anywhere in the world. Do you know any? Write for our plan to show you by actual performance.
ELECTRIC ARC CUTTING & WELDING CO.
152-158 Jeliff Ave. Phones, Waverly 7802-7803 Newark, N. J.

Acetylene from Cakes

Compact, clean "bricks" that slip easily and quickly into the Carbic portable generator and supply highest quality acetylene, without fuss, muss or waste—that's the Carbic system.

Carbic is a standardized product. Thousands of tons of Carbic are made each year, all for use in Carbic portable generating equipment.

As a source of acetylene supply, Carbic is serving welding and repair shops, foundries, railroads, mines and a multitude of others at all points of the compass.

Let us tell you more about the Carbic system of generating from the Carbic cake.

Carbic Cakes are packed in sheet metal drums and will last indefinitely. Stocks carried in principal cities.

Carbic low pressure, portable generator. Weight charged—200 lbs. Listed as standard by Fire Underwriters' Laboratories.

CARBIC MANUFACTURING CO.

DULUTH, MINN.

New York, 141-149 Centre St. Chicago, 565 W. Washington Blvd.
Boston, 27 School St.

Warehouses and Representatives in other principal Cities.

Trade **Carbolite** Mark

A ONE BRAND, HIGHEST QUALITY

CALCIUM CARBIDE

The trade name Carbolite has represented our product continuously for many years. Its appearance on each package is a guarantee of its excellence and a protection to our customers.

Carbolite is carefully manufactured from best grade raw materials insuring at all times a superior quality, both in purity and gas yield. Our modern screening and inspection system also makes certain a thoroughly clean product, uniform in size.

Carbolite is made in all standard sizes and can be supplied promptly from warehouse stocks.

Packed only in Yellow Containers

American Carbolite Sales Company

General Offices

DULUTH, MINN.

WAREHOUSES IN ALL CENTRAL STATES